INVENTIONS, INNOVATIVE RESEARCH AND PRODUCTS 2000

UNIVERSITI PUTRA MALAYSIA

Inventions, Innovative Research and Products

2000

Universiti Putra Malaysia

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Universiti Putra Malaysia
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Kata-Kata Aluan

Kamel Ariffin bin Mohd. Atan

Sepanjang hampir tiga dekad yang lalu, pegawai akademik Universiti Putra Malaysia (UPM) yang dahulunya dikenali sebagai Universiti Pertanian Malaysia telah berjaya menyumbang dengan agak banyaknya kepada peningkatan dan kemajuan ilmu pengetahuan yang telah menghasilkan pula rekacipta-rekacipta teknologi, di samping memberi latihan kepada sumber tenaga manusia untuk pembangunan negara dan juga membangunkan kerja-sama dengan sektor industri.

Sebagai mengiktiraf sumbangan UPM kepada aktiviti penyelidikan dan pembangunan negara, Majlis Penyelidikan dan Kemajuan Sains Negara telah mengisytiharkan UPM dengan PORIM sebagai pemenang bersama dalam kategori Institusi Penyelidikan dan Pembangunan terbaik di Malaysia.

UPM terus mendahului institusi-institusi P&P yang lain di Malaysia termasuk universiti-universiti awam dalam menerima peruntukan penyelidikan ter-banyak dan juga bilangan tertinggi projek penyelidikan yang diutarakan dalam kategori penyelidikan IRPA. Untuk mengekalkan kedudukan terkehadapan penyelidikan dan untuk menyemai budaya penyelidikan di UPM, Perancangan Koporat UPM 1995 telah meletakkan di tempat yang utama aktiviti rekacipta dan penyelidikan yang bermatlamatkan pengkomersilan. Pada tahun itu juga UPM melancarkan Anugerah Rekacipta dan Penyelidikan untuk memberi pengiktirafan kepada sumbangan-sumbangan pegawai akademiknya. Penganugerahan Rekacipta dan Penyelidikan bagi kali yang kedua akan dilaksanakan pada 8 hingga 10 April, 2000 dalam satu upacara yang dimuatkan dengan acara pameran hasil-hasil penyelidikan. Dengan menyatukan penyelidik-penyelidik kita semuanya saya percaya kita mampu untuk meningkatkan lagi teknologi-teknologi yang wujud di UPM pada masa ini.

Pemerihalan Rekacipta dan Penyelidikan Berinovasi yang dipamerkan dan hasil-hasil penyelidikan yang boleh dikomersilkan di UPM ada terkandung dalam buku *"Inventions, Innovative Research and Products"*. Saya yakin maklumat-maklumat yang ada sangat berguna kepada para "entrepreneur" dan sektor swasta yang ingin meneroka hasil-hasil dan perkhidmatan penyelidikan yang ada di UPM.

Akhir kata, saya ingin mengucapkan ribuan terima kasih kepada IRPA di atas sokongan yang telah diberikan kepada hampir semua projek yang disenaraikan dalam buku ini. Kepada para penyelidik dan pegawai akademik UPM, saya ingin menyampaikan sekalung tahniah dan syabas di atas kesungguhan, dedikasi dan sumbangan berharga yang telah mereka berikan.

Professor Dr. Kamel Ariffin bin Mohd. Atan
Timbalan Naib Canselor (Akademik)

Foreword

Kamel Ariffin bin Mohd. Atan

For almost three decades, the academic staff of Universiti Putra Malaysia (UPM), formerly known as Universiti Pertanian Malaysia, have significantly contributed to the advancement of knowledge resulting in technological Inventions, training skilled human resources for nation building and forging partnerships with the industry.

In recognition of UPM's contribution to Research and Development, the National Council for Scientific Research and Development declared UPM and PORIM as the joint-winners for the best R&D Institution in Malaysia.

UPM continues to lead Malaysian R&D institutions including the public universites on funding and research projects under the Intensification of Research in Priorities Areas (IRPA). To sustain UPM's leading edge in research and to instill the culture of research, UPM's Corporate Plan of 1995 placed high priority to invention and innovative research as the paths to commercialising research findings. In the same year, UPM inaugurated the Invention and Research Awards (Anugerah Rekacipta dan Penyelidikan) to recognise the contributions of its academic staff. The second Invention and Research Awards is scheduled for 8 to 10 April 2000 on a grander scale with an exhibition of findings. By bringing our researchers together, I believe we can improve the technologies, which exist at UPM. We can also determine how to achieve a competitive advantage that will enable us to expand into other areas in research.

The description of the Inventions and Innovative Research on display and also products available for commercialisation at UPM are contained in the book — "*Inventions, Innovative Research and Products*". I am confident that the information would be useful for entrepreneurs and private sector exploring for new products and services available at UPM. They will meet the innovators and researchers face-to-face.

In conclusion, I wish to acknowledge IRPA for supporting almost all projects included in this book and my sincere congratulations to the academic staff for their dedication and contributions.

Professor Dr. Kamel Ariffin bin Mohd. Atan
Deputy Vice-Chancellor (Academic)

Section I - Inventions

Even the simplest idea can be worth a fortune to a person if it fills the wants or need of others — a product, process of creative imagination

UPM inventions cover a broad field. These are available for licensing to companies in the private and public sectors.

SIMULATED ACCOUNTING CYCLE SOFTWARE (SKIP)

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SKiP is a product on the integration of IT in the accounting curriculum. It is designed specially as a teaching and learning tool for basic accounting. Bookkeeping skills and the ability to prepare full sets of accounts are prerequisites to the learning of advanced level accounting. Given the mechanical and repetitive nature of a manual record keeping process, students may not perceive it as interesting. SKiP, a technology-based tool provides an alternative to their learning method.

By integrating salient characteristics of an industry accounting package, SKiP is able to provide at an early learning stage, a simulation of accounting systems as practised at the work place. However, unlike the use of industry software, with SKiP, the bookkeeping logic and requirements are not sacrificed. This means that students' skills and knowledge in keeping accounting records can be enhanced. The personal version of SKiP comes in the form of only one floppy with a user manual. Hence, students are provided with an opportunity to practise according to individual time, location and ability. From teaching perspective, SKiP is able to assist educators assess students' ability and understanding of subject matter, resulting in more effective teaching. It is not only appropriate for use at institutions of higher learning and schools but also as training material for accounts personnel of various organisations.

Reported as the first software of its kind published in Malaysia, SkiP's commercialisation process commenced with the launching of the Bahasa Melayu version in July 1998 by the Deputy Education Minister. The English version was published in January 1999. In an effort to promote the use of IT in accounting education, the Malaysian Association of Certified Public Accountants (MACPA) has sponsored the distribution of complimentary copies of SKiP to secondary schools nation-wide. It also recommends that SKiP be integrated into the accounting curriculum of public institutions of higher learning. At the same time, at the invitation of the Technical and Vocational Education Division of the Ministry of Education, several workshop sessions on the use of SKiP have been conducted for the Principles of Accounting teachers throughout the country.

TRANSPORTATION OF OIL PALM FRESH FRUIT BUNCHES

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Acute labour shortages and escalating labour cost have prompted the introduction of mechanisation in the harvesting and collection of oil palm fresh fruit bunches. Problems of low productivity and operation for the infield collection-transportation of fresh fruit bunches could be now overcome with the usage of the track type FFB PICKER MRK-I and wheeled type FFB PICKER MRK-II. Both machines adopt a fully integrated continuous one-man once over collection-transportation operation principle for greater output capacity and manoeuvrability in the plantation. Their designs are simple for easy operation and maintenance, yet robust for high durability over rough and uncertain field terrain.

The overall construction of the machines consists of the main chassis and driving unit, collection assembly, fruit bin, operator cab and electro-mechanical control unit. Picking mechanism of collection assembly is located at the machine frontal for better operator visibility and control. The fruit bin is designed with 1500-kg payload to cover the present standard field layout and collecting practices.

Various functional components within the machines are hydraulically operated through an electro-solenoid control system with selectable manual and automatic functional operation modes. The MRK-I is equipped with a low ground pressure track to provide maximum traction and floatation on flat and soft terrain. Where else, MRK-II has a combination of 4-wheel drive, oscillating front axle and dual rear drive tyres to provide maximum traction and floatation on steep and undulating terrain. The machine is also equipped with a single stage scissors lift fruit bin with 2750-mm maximum raise height for direct unloading of the fresh fruit bunches into the main line transporter.

Only one operator is required to drive and operate the machine for evacuating fresh fruit bunches, unlike the common machine-system with a driver and loader. Besides reduction in the total dependence of labour, both machines could reduce the collection-transportation time, and makes agriculture an attractive profession in Malaysia.

SLUDGE TO PRECIOUS STONE - TECHNOLOGY OF HIGH TEMPERATURE MELTING

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The volume of sewage sludge produced in Malaysia is increasing at an alarming rate of about 6.6 million tonnes by year 2020. The new method of treatment using thermal technology for destroying the solid and followed by utilisation of the by-product offers great promise not only in reducing the quantity of the waste but also able to produce a valuable stone-like product. The research focussed on finding suitable temperature for sludge treatment so as to produce a safe and usable construction material (called sludge-stone).

The sewage sludge can be destroyed using high temperature melting at 900 C to produce stable ash. Above 1250°C, the ash will melt to form stabilised stone. The properties of the product are safe in terms of leaching. The result indicated that all heavy metals found in the stone are fixed permanently and no leaching occurs upon testing over 24 hours.

The physical and chemical properties of molten slag are very superior in quality than other building materials and can be a good replacement to replace some proportion of cement and sand in concrete manufacturing. The product also gives crystal-look appearance.

The outcome of research is the production of incinerated ash and stabilised molten slag (called sludge-stone) at different temperature; it is safe for use in construction. The incineration and melting has been successful is reducing the weight of the waste to only 3.2 %. The result will be very beneficial to many sectors dealing with sludge disposal especially Indah Water Konsortium and brick manufacturers.

The high temperature treatment technology can convert harmful domestic sewage sludge waste into a precious stone product (known as sludge-stone). The process destroys the pathogen in sludge and reduces the mass to only 1.9% of the original volume. The commercial potential of this technology is the production of crystalline solid which can be utilized. The unwanted sludge can be reclassified as a resource to building and construction material.

PRODUCTION OF HIGH PERFORMANCE ADHESIVE FROM ANIMAL WASTES

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Animal wastes account for about 25% of the animal's bodyweight. The wastes being organic undergo rapid degradation to cause a serious environmental pollution problems, such as the release of foul odour due to bacterial decomposition and contamination of the surface and groundwater if not properly treated. Animal skin and bone can be utilised to produce a very strong glue for paper and board manufacturing.

We have developed an innovative process for the production of high performance adhesive glue. The new adhesive possesses excellent physical and chemical properties compared to commercially available Melamine-urea-formaldehyde (MUF) adhesive. Not only is the adhesive cost-effective solution in animal waste management but also developed a new product for our furniture and housing industry.

Our research has produced a high performance adhesive resin (glue), which possesses the following advantages: (a) is non -toxic compared to conventional urea formaldehyde glue, (b) is economical (the glue possess indefinite pot life), (c) is suitable for veneer application, (d) is cheaper than melamine formaldehyde MUF (conventional), and (e) is a cost-effective solution to utilisation of animal by-products (e.g. hide and skin scrap).

Features of the invention:

- ☆ Production of a high quality glue by extracting collagen from animal skin,
- ☆ A higher yield (up to 50 % compared to the conventional process using the optimum conditions) within a very short time,
- ☆ Increased gelling strength up to 10 %,
- ☆ Reduction in the swelling capacity by 30 %,
- ☆ Reduction in the solubility of the glue,
- ☆ Improved resistance to moisture and bacterial attack, and
- ☆ Direct application as a hot melt adhesive for the furniture and housing industry.

LOCAL HORSE FEED FROM AGRO-INDUSTRY BY-PRODUCTS

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The cost of management of horses in Malaysia is high and therefore had been highly inhibitive to participation of the middle and lower income group in horse activities. The cost of maintenance of horses is estimated to be more than RM 1000 per month of which more than 50% is the cost of feeding the horses with high-cost imported feeds. Thus using the local agro-industrial by-products will reduce the cost of feeding horses, hence reducing the total cost of management.

This research, conducted in UPM has identified agro-industrial by-products, for the formulation of feed at least cost and yet meeting all the requirements of the working horse. The formulated feed was then tested in the laboratory to determine to ensure its nutritive value does not differ with the formulation created using a computer programmed and meet all requirements of the work horse. The formulated feed was then manufactured and subjected to trials using specific research working horses to evaluate the acceptance, palatability, suitability, digestibility, and side-effects. The trial was extended to other workhorses to determine the quality of the formulated feed while comparing with imported feed.

The 3-year research have enabled UPM to formulate a high-quality horse feed, comparable with the imported feed, but using local palm kernel cakes, wheat pollard, padi straws, molasses, electrolytes, vitamins, and minerals. It cost of only 58 cent per kilogram, which is less than half the cost of imported feed while maintaining comparable nutritive value and quality. The cost of this feed is expected to be cheaper under commercial production. This low cost high-quality local horse feed is therefore expected to propel the horse industry to greater heights, with the participation of people of all walks of life.

Management of horses through the use of cheaper horse feed will reduce the cost of management and the cost of horse-related activity in general. Everyone irrespective of income levels of society hence will enjoy equine recreation.

WEB-BASED DYNAMIC AND INTERACTIVE DISTANCE LEARNING SYSTEM (WEBED)

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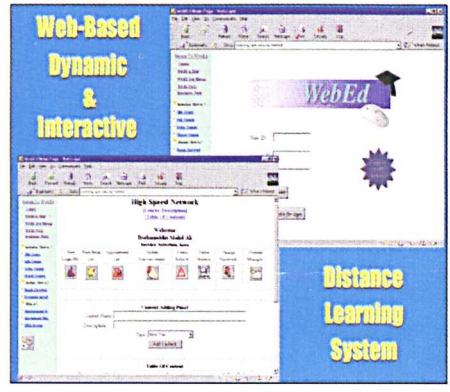

WebEd is a user-friendly system that facilitates the information provider or the instructor to carry out web-based courses. The WebEd approach makes the instructor centrally involved and maintain the ownership of the courses while. enabling students to access the course and interact with the instructor.

WebEd distance learning system is dynamic and interactive. It has been built using Java and CGI script. In order to handle the dynamically generated pages and services, a *JavaCGI* proxy has been developed. The system was designed on a 3-tier architecture which splits the system processing load between the client-side workstation that runs on a browser, web server that sends HTTP commands over a network and WebEd services that handle the web-based distance learning activities. No installations are required in order to access the system, as the courses are accessible via a browser.

With WebEd, virtual class becomes possible to allow more students to receive their education without attending particular classes as applied by the traditional learning method. Thus the educational institution can optimise the physical facilities like classes, for other purposes. The system also benefits part time students in a distance learning program who normally face constraints in terms of time and mobility. Also, WebEd can become an important supplementary aid to the lecturers-students relation by providing easy, fast, interactive and efficient services.

DESIGN, FABRICATION AND PERFORMANCE OF A PEANUT HARVESTING MACHINE

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A peanut harvester suitable for operation by a 35hp tractor has been designed and developed at the Department of Biological and Agricultural Engineering, UPM, Malaysia. The machine consists of adjustable V-shape digging blade while the angle of penetration easily adjusted with the help of bolts and nuts. Double discs lifter for gripping the loosened plant above the soil surface, follows the digging blade. The loosened plant enters into a threshing mechanism, which separates the pods and transfers them to the tank at the end of the machine via a conveyor. The total power requirement of a single row machine is about 12kw (16hp).

The machine has an average capacity of 324.9kg/h. Overall efficiency is 78.1%, which is considered high when compared with other combines efficiencies. The machine initial and fabrication cost is lower (about US $1455). Machine test showed that the losses for digging, lifting, stripping and conveying were 6.23%8.65%, 5.06% and 1.96% respectively, while pods breakage scored lower percentage when compared with the previous results. In terms of weight, the machine is very light (about 625kg). This facilitates easy hitching and transporting by the tractor.

The field test showed that the machine was suitable and efficient for peanut harvesting in rainy seasons (The test was done at high soil moisture content about 42.8%). Machine performance test achieved good results on clay soil (Munchong Series Soils). Results from the field test show that the machine is suitable for harvesting peanut in a single operation.

PUTRA J-58: THE GRAIN MAIZE HYBRID VARIETY

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Putra J-58 is the first grain maize hybrid variety ever developed and released in Malaysia, for use as animal feed. It was launched by the Minister of Agriculture, at the Faculty of Agriculture, Universiti Putra Malaysia, on October 8, 1998. Being a hybrid, plants of Putra *J-58* reveal extremely high vigour, and produce 25-35% higher grain yield (6.2 m.t./hectare) than the available composite varieties. Other advantages of this variety are early maturity, short and uniform plants, tolerance to pests and diseases, ability to adapt to various environments, high grain nutritional quality and its suitability for mechanised commercial cultivation.

This variety was developed at the Faculty of Agriculture, UPM in three main phases. Firstly, *Development of Base Populations (Years 1987-1990),* of five improved populations by recombining 10 populations obtained from Southeast Asia. Secondly, *Development and Selection of Inbred Lines (Years 1990-1993),* of 20 most potential lines. Thirdly, *Development and Testing of Hybrids (Years 1993-1998),* through on-site evaluations. After detailed evaluation on all aspects of its uniqueness at various locations in the country, one of the single-cross hybrids was declared as *Putra J-58.*

This Invention conforms to the government's initiative on encouraging local food production to offset cash outflow from food and feed importation. With the yielding capability of *Putra J-58,* local cultivation of grain maize, which was earlier considered non-profitable, has give new confidence to commercial growing of maize in Malaysia

Besides the many requests for *Putra J-58* seeds for commercial grain maize cultivation from Government agencies and the private sector, UPM has signed a Memorandum of Understand (MOU) with Gabungan Pengusaha Makanan Bumiputra Malaysia (GPMM) for their co-operation in producing the hybrid seeds for commercial planting.

THE DEVELOPMENT OF STRENGTH MEASURING DEVICE FOR HARD SOIL, WEAK ROCK AND CONCRETE (SMALL-PRESSUREMETER (S-P) TENSILE TESTING DEVICE)

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A Small-Pressuremeter (S-P) is a new device to measure the indirect tensile strength of weak rock, hard soil and concrete. It is developed by a group of researchers from Mountainous Terrain Development Research Centre (MTD-RC). The S-P is protected by a patent and won the Bronze Medal for International Invention, Invention, Industrial Designand Technology Exhibition (I.Tex'99).

The Small-Pressuremeter (S-P) is a cylindrical probe with an expandable flexible membrane designed to apply a uniform pressure to the walls of a cavity, such as a borehole. There is no need to cut core specimens to a particular shape for S-P testing, making it an attractive option for weakly bonded rocks, hard soils and concrete. It is only necessary to pre-drill a small hole so that the S-P can be inserted. The S-P is then inflated using a suitable fluid (usually de-aired water) until the specimen fails, while volume and pressure are monitored.

The S-P is a hollow steel tube 12mm in diameter, open at one end with a hole in the mid-portion of the curved surface, and 50mm in length. A membrane encloses the central portion of S-P and is attached at either end with special clips. The membrane is calibrated by inflating the membrane in air, with the S-P placed upright. New membranes are inflated and deflated several times prior to calibration. For line calibration, the membrane was inflated inside a thick walled steel cylinder. The thickness of the membrane is 1.0mm.

The Small-Pressuremeter is a useful method for testing extremely weak rock materials and hard soils in the laboratory. It is small and compact, easy to handle, costs less than other indirect tensile testing equipment currently available in Malaysia.

TRANSFORMATION OF AN OLD PC-486 TO AN AUTONOMOUS-GUIDED VEHICLE

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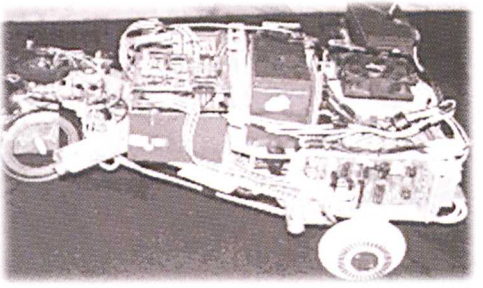
Technology of nowadays is more towards the more demanding on intelligent system than the past decades. The need for a self guided vehicle has been rapidly expanded due to the ever-changing technology of computer, computer science and sensory technologies. The use of self-guided vehicles is increase in automated factories and other well structured environments. Most of the self-guided vehicles in present use, however, are not really autonomous but they rather rely on "tracks" imbedded in, or painted on the factory, hospital or office floor to guide them from one station to another.



A prototype of autonomous-guided vehicle (AGV) was developed using recycle components such as an old PC 486 motherboard, bottle caps, dc motors, stepper motors, and sensors This leads to a low cost production of this prototype. This AGV has a tricycle configuration with a single front wheel, which serves both for steering and driving the platform and two passive load-bearing rear wheels. It is capable of navigating in structured environments such as hall room without external guide's tracks. Other features available from this AGV include a defensive over-steer mechanism, tele-operation, sonar obstacle detection, path-vector tracking with learning capability, light and arm manipulator.

This AGV can be used for industry and military applications. It also can be used for mobile platform of robotic and intelligent mechanism or served as an educational material in the teaching laboratory. This AGV has a big commercial potential.

RF-BASED CAR PAGER SYSTEM

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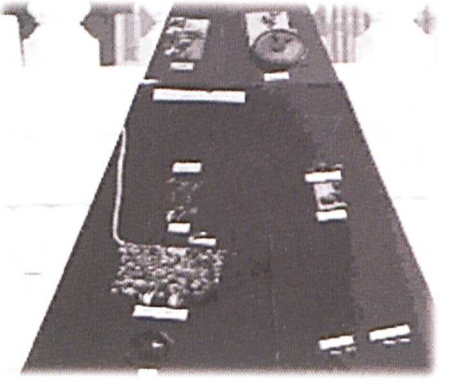

According to the data provided by the Polis Diraja Malaysia, the number of vehicles being stolen or vandalised has increased greatly for the last few years. Although currently there is a normal security alarm system fixed in every car, statistics show that this system is not effective. The problem with this system is that the alarm has limited effective working range. The user will not know what is happening to his/her car when the car alarm is triggered, especially if the car is parked far away from the user.

A low cost prototype of RF-based car pager system was developed to solve the above problem. This system is interfaced with a standard security alarm system of the car.

Basically, this system has three main sections namely a car security anti-theft alarm unit, an UHF transmitter-receiver set and a beeper circuit. When the car security alarm is triggered, the system informs the user through the car beeper attached to the car key chain,. This is achieved by sending the signal from the security alarm system transmitter located inside the car to the user via air propagation or radio frequency (RF). The receiver, which is located in the car beeper, will process the signal and generate an audible sound to the user. This means that when a person who parks the car outside the office building and is working in the office would hear an audible sound from the car beeper if the car alarm is triggered.

This system also can be implemented in other vehicle types and security systems. This system has commercial potential and should be of interest to the vehicle manufacturers.

MICROWAVE REFLECTION METER FOR MEASUREMENT OF MOISTURE CONTENT, DENSITY AND STAGE OF DECAY OF WOOD AND OTHER APPLICATIONS

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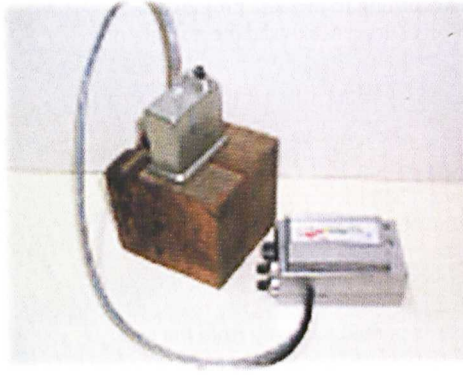

An instrument based on microwave reflection method and working at 10.7 GHz has been developed for measurement of moisture content, density and stage of decay in wood. It has been designed for ease of use, portable, cheap and non-destructive. The accuracy is at the level of ± 2% for moisture content, ± 3% for density and be able to classify the stage of decay as severely decay, partially decay and sound wood. Another speciality of this instrument is its ability to detect fibre saturation point of the wood, which is important parameter in wood drying industry.

The is work contributes to the advancement of knowledge with respect to the relationship of microwave dielectric properties of wood with moisture content, density and analysis of the transmission, and reflection phenomena for the optimisation of the sensitivity of sensor. Both wood and construction industries can benefit from this project since moisture content is the main criterion in drying wood while density is important criterion to determine the quality of wood.

In Malaysia, some transmission lines such as 132 kV and 275KV are constructed with wooden cross-arms and chengal are used extensively for this purpose. Due to natural weathering, the wood will decay and need to be monitored before any accident could occur. Therefore this instrument can be used for routine inspection of the stage of decay of the wooden cross-arms. Yet another potential application of this product is for the detection of plastic or metal pipes buried under the concrete. These pipes normally carry electrical wires or water and the locating the position of these pipes will help us to avoid this area before any drilling is done.

NEWCASTLE DISEASE VIRUS, NDV

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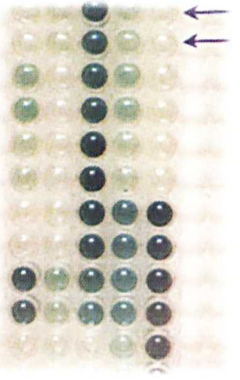

The Newcastle disease is a virus (Newcastle Disease Virus, NDV) infection affecting poultry in Malaysia, resulting in large economic losses. Early detection and identification of the virus is important in order to contain the disease and to prevent its spread. Current methods are available for its diagnosis, for example agglutination, haemagglutination and ELISA methods but these suffer from low sensitivity and specificity. Our research group has recently developed an alternative method that overcomes these problems of poor sensitivity and specificity. This method is based on a combination of the reverse transcriptase-nested polymerase chain reaction (RT-nested PCR) and the ELISA methods and has the advantage of being performed as a single tube reaction mixture.

Using our technique, four specific primers are designed based on the nucleotide sequence of the fusion gene of NDV. Two of these primers are labelled with biotin and digoxigenin at each of the 5' terminus to enable their detection using non-radioactive method. These primers are highly specific in enabling the identification of all the three different pathotypes of NDV. No cross reactions with other avian infectious agents such as infectious bronchitis virus, infectious bursal disease virus, influenza virus and fowl pox virus were observed.

The detection limit of this nested PCR technique was a 100-fold more sensitive that of a non-nested RT-PCR upon using the agarose gel electrophoresis as the detection method. The latter however, can be replaced by the ELISA detection method in a 96 sample well microtitre plate, resulting not only in simplification of the handling procedures but also increasing the number of samples that can be analysed simultaneously. Furthermore, the combination of the nested RT-PCR technique with the ELISA detection method also improved the sensitivity of the test by an extra 10-fold. Compared to other diagnostic methods mentioned above, our technique produces results within 10 hours while the other methods require between 5 to 10 days.

WHITE SPOT SYNDROME VIRUS DETECTION KIT

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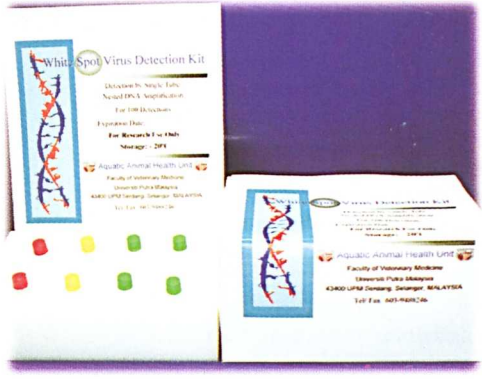

A rapid test kit, using an innovative method for the detection of white spot syndrome virus, is being produced by Professor Mohamed Shariff and his research team and sold in many countries hit by the disease. The diagnostic kit, using the first advance automated, single tube approach to detect white spot syndrome virus or commonly referred to as "white spot syndrome" (WSS) is radically different from the traditional nested PCR method involving cumbersome two tube or multiple step procedures. This novel single tube method for the shrimp virus is the first in the world and is patent pending.

Since 1992, WSS in penaeid shrimp, has overshadowed all other pathogenic agents, resulting in major losses to the shrimp industry in many Asian countries. In China for instant, shrimp culture production recorded a loss of 80% which was equivalent to about US$1 billion. Recently, the disease spread to the Latin America causing losses of several million Dollars. The serious economic losses in the shrimp culture industry necessitated the development of effective diagnostic kit.

Realising the disparity that occurs in diagnostic assays in the two-step PCR methods currently available, Professor Dr. Mohammed Shariff and his team of researchers developed the single tube method. The kit has been designed to meet the high standards avoiding the need for multiple step procedures. The white spot detection kit sold under the trade name "FastTarget™ WSSV detection kit" is the most complete PCR test kit for WSSV available to date.

After loading the DNA sample, all steps are automatically performed within one reaction vessel. The detection system comes complete with built-in false negative and false positive controls including all necessary reagents to perform single-tube nested PCR. The reduced hands-on manipulation of the reagent preparation makes the system more robust. Apart from being cost-effective in the analysis of samples, the kit is sensitive and able to reliably detect 10 copies of viral genetic targets. The kit can also be used to indicate the level of infection in the sample tested through easy distinctive PCR bands visualisation.

PRODUCTION OF BIOPLASTICS FROM PALM OIL MILL EFFLUENT WITHIN A ZERO DISCHARGE SYSTEM

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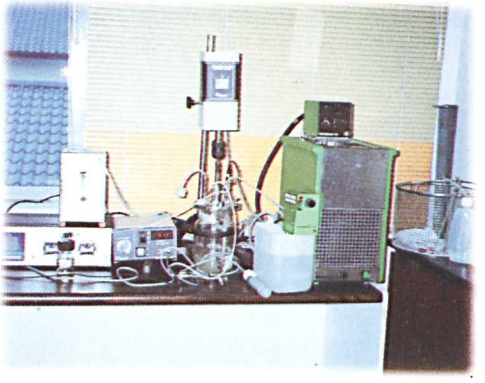

Currently palm oil mill effluent (POME) is treated mainly to remove its high biological oxygen demand (BOD) in order to meet discharge standards prior to disposal. The most common treatment system presently employed in Malaysia for POME is the anaerobic ponding system whereby the biogas produced is released into the atmosphere. However, with its high organic content (more than 20,000 mg/L BOD) and being non-toxic, POME could serve as a suitable carbon source in fermentation systems for the production of value-added compounds, reduce the environmental pollution and in line with the concept of clean processing or zero discharge system.

We have developed an integrated process incorporating the controlled anaerobic treatment of POME to recover organic acids and finally fed-batch production of bioplastics (polyhydroxyalkanoates or PHA) under open and non-sterile conditions. For a typical mill processing 60 tons fresh fruit bunch per hour or 81000 tons fresh fruit bunch per year, about 100 tons PHA could be obtained per year upon recovery. The clean water could be partly recycled (15000 tons per year) and the remainder safely discharged due to its low BOD of 80 mg/L. The energy required could be generated within the mill itself, since the palm oil industry is an energy-surplus industry.

We have produced organic acids by both the evaporation system and open non-sterile fermentation technique from POME. These organic acids, used as fermentation substrates to produce bioplastics, could be concentrated to 100 g/L for use as substrates for the fed-batch fermentation. The concentrated organic acids were successfully converted to PHA by *Alcaligenes eutrophus* Upon condensation of the steam, the BOD of the water was low enough for it to be either recycled or discharged

The success of these operations suggests that by integrating all these processes, it is possible to establish an appropriate zero discharge system for POME incorporating the production of bioplastics.

ENGINEERED WOOD I-JOIST AND LAMINATED VENEER LUMBER FLANGES

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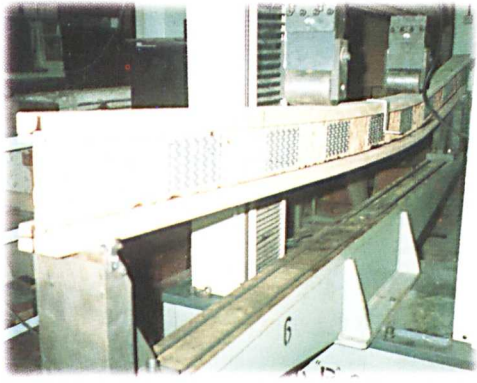

Problems of low-cost housing system have continued to be a primary research and development area for the engineering use of wood composite such as Laminated Veneer Lumber (LVL) and Oriented Strand Board (OSB). Engineered wood I-joist is a system that consists of flanges and web component. Both components have to work together as a system in order to match the strength property of solid wood. The strength properties of engineered wood I-joist made from three types of jointed OSB webs (Finger, L-butt and Nail plate) and 2 types of flanges (solid wood and LVL) were investigated. It is found that I-joist specimen with finger jointed web was the strongest whereas I-joist specimens with nail plate jointed web was the weakest.

Even though specimens with nail plate joints were the strongest among the three types of joints in the OSB web strength test (without flange), it was the weakest when it was used with the flanges in the I-joist. Probably, the embedded nails of the nail plate caused the OSB to be overly stiffened at the joints and thus reduced the strength of the whole system of the I-joist. Although I-joist specimen with L-butt jointed web had the simplest structure, it performed better than I-joist specimen with nail plate jointed web. However, it was not as strong as I-joist specimen with finger jointed web.

Data from this study would be useful in fabricating I-joists and has potential applications. Fabrication of this type of engineered I-joists will reduce costs without sacrificing their strength. LVL offers more advantages than solid lumber as flanges.

OSB is a new type of wood composite in Malaysia. It could be obtained from the off-cuts and rejected boards, thereby increasing net profit. This new raw material to produce I-joist in combination with synthetic materials could result in building materials that is lightweight, strong and environment-friendly.

BROAD-SPECTRUM ANTI-TUMOR "DNA VACCINE" THERAPY FOR ANIMAL AND HUMAN CANCEROUS CELLS

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Realising the importance of tumour therapy, we have taken a significant step to develop a new approach towards curing tumours. An anti-tumour gene has been identified and obtained from a virus infecting chicken. The virus was not found to infect other species but the anti-tumour activity of the gene obtained has proven to break species barriers. With a modification, DNA sequencing and cloning of the gene into the suitable plasmid carrier, the recombinant plasmid has been tested in numbers of tumour cells. The product has been named as APOVAX anti-tumour "DNA vaccine".

Tumour or cancer is one of the main health problems of mankind including pet animals, livestock and wildlife. Current methods of treatment include chemotherapy, radiotherapy and surgery. However, the effectiveness of these measures is subjected on types, location and severity of the tumour.

Many studies have shown that "apoptosis" plays an important role in cancer. This process is a cellular suicidal pathway, which is different from the natural cell death. Most apoptosis occurs following anticancer chemotherapy is facilitated by an activation of a protein (named as p53) that capable of suppressing the growth of tumour cells. Thus only tumours that produce protein p53 can be treated by such measure. However, many tumour cells (especially breast and lung tumours) do not contain functional protein p53. Thus anti-tumour treatments, which depend on the presence of protein p53 are not useful. Furthermore, most chemotherapy as well as other measures are not tumour cell-specific, and normal cells become casualties.

☆ The APOVAX anti-tumour "DNA vaccine" has been tested on tumour cells of monkey, hamster and human origins. These cells of different species were very responsive to the treatment. Interestingly, no effect was observed in normal cells receiving the same treatment. It has been shown that the killing of such tumour cells with our anti-tumour product is independent of protein p53 function. In this study, only tumour cells died within 5 to 7 days of the treatment following a single treatment with the APOVAX.

THYMIDINE-KINASE GENE-DELETED AUJESZKY'S DISEASE VACCINE

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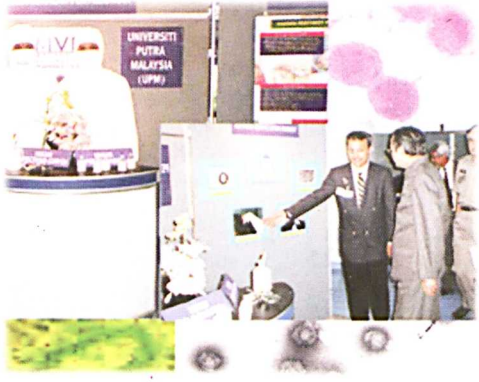

An effective live Pseudorabies or Aujeszky's disease (AD) vaccine has been developed using genetic engineering to modify and convert a local virulent AD virus to a non-virulent form. The vaccine is much safer and safer than other live AD vaccines in the market. Our virus vaccine does not cause any harm or clinical signs of infection, at least in laboratory animals, compared to most live AD vaccines in the market. Animals vaccinated with the vaccine are fully protected from infection by endogenous and exogenous virulent AD virus strains. No abortive or reduced-fertility observed in sows.

After careful selection and cloning of the virus in cell culture, the virus selected was subjected to molecular cloning and DNA sequencing of the desired gene of interest (thymidine kinase gene). The gene responsible for the virulence (causing disease) of the virus was removed. Then gene-deleted AD virus was selected, cloned, stabilised and well adapted in cell culture. The vaccine virus is unable to reverse its virulent state. Rigorous tests on the potency of the virus have been conducted in laboratory animals as well as in pigs.

AD causes severe economic losses to the pig industry worldwide. Most farmers use imported killed vaccines to vaccinate their sows so that their litters acquire passive immunity from colostrum. Malaysian imports on AD vaccine amount to about RM 1 million per year. However, as the transient passive immunity declines, growing animals are not protected. Infected animals act as a source of virus for subsequent infection. Killed vaccines are seldom recommended for weaned animals due to their prohibitive costs. The cost of complete vaccination could be as high as RM 5.00 per animal per year. Then vaccination of 1,000 sows would cost the farmer RM 10,000.00 a year.

PRODUCTION OF VEGETABLES BY THE AEROPONICS SYSTEM

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An aeroponics system has been developed for the production of leafy vegetables such as lettuce, Amaranthus, Sawi and Kale. The aeroponics system consists of a trough, pipes, a pump as well as a tank for nutrient solution. This system differs from the conventional hydroponics system by the roots of the vegetables being exposed and droplets of water or fogging continuously water the roots.

Aeroponics opens up an emerging technology for the agriculture sector. With the emphasis on the problem of environment and food poisoning from pesticides, the new technique can improve the socio-economic well being of the consumers in terms of food quality and health.

From the standpoint of technological development, we have leapt into the new millennium with the most sophisticated system to meet the current situation and changing technology. This system is most suited for the industrial areas because it is controlled electronically by a computer monitoring system, and does not require much labour.

From an economic point of view, the aeroponics system has excellent commercial potentials if the cost of infrastructure can be reduced. Entrepreneurs can invest in the system and can get good return if the value of vegetables is high.

OIL PALM-BASED ACTIVATED CARBONS

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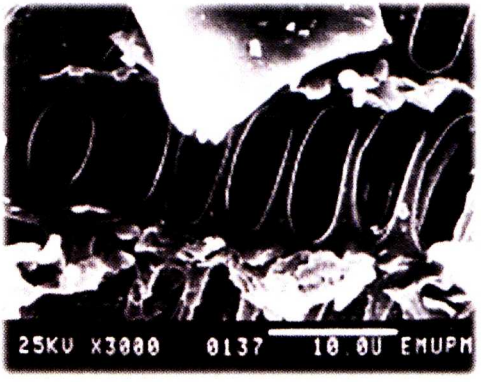

Activated carbon is a porous carbonaceous material with surface area of around 300-3000 m^2/g. Due to its high surface area and porosity, activated carbon has a very high adsorptive capacity. This and other properties can be modified, enhanced or tailor-made for many applications in gas or air treatment, water purification, food, chemical and pharmaceutical industries as well as special application such as batteries and catalysts support.

Oil palm based activated carbons can be prepared using chips of oil palm trunk, oil palm shells and other oil palm residues as the raw materials. The resulting properties of the activated carbon i.e. the surface area and type of pores required can be adjusted by adjusting the amount of chemical and physical activators. The properties of the resulting activated carbon can be further enhanced or modified using other treatment. High surface area oil palm-based activated carbon can be tailor-made to the requirement of its surface properties by adjusting the amount of the activator.

Production of activated carbon from oil palm by-products has a long term and far-reaching effects. Besides tapping the raw material namely oil palm trunk, oil palm shells and other oil palm residues available in large quantities throughout the country, it can generate more income to the raw materials supplier, i.e. planters, small holders and workers. Conversion of oil palm residues to value-added product such as activated carbon will increase the output of the oil palm industry and turning the by-product into a resource for another industry. This is toward "zero-waste" industry and promoting a clean environment.

The quality of the activated carbons is as good as or better than the activated carbon currently available in the market. Modification and enhancement of specific properties can be done. The adsorption properties, surface area, porosity and mechanical strength can be tailor-made to the requirement by adjusting the activation process and using different raw materials. Production of activated carbon from by-products of the oil palm industries is commercially viable because it is a cheap renewable resource easily available throughout the year.

STONE MASTIC ASPHALT WITH OIL PALM FIBRE FOR MALAYSIAN ROADS

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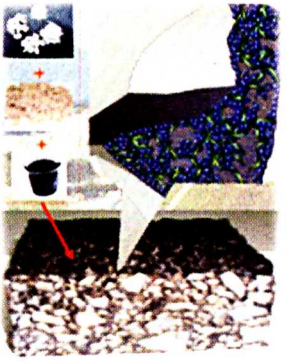
The maintenance cost for Malaysian road is very high. For the past ten years, an estimated RM3581million was spent to build roads, of which RM1560million was spent on the maintenance of the existing roads due to the fatigue cracking, rutting and stripping problems.



To reduce the overall cost of road laying and maintenance in Malaysia, an alternative advanced and durable pavement mix called Stone Mastic Asphalt (SMA) has been developed at University Putra Malaysia (UPM). A new fibre technology also being developed will ensure the durability of this pavement.

The UPM's Stone Mastic Asphalt is a gap-graded mix with a high coarse aggregate content of 70-80%, binder content of 6.5-7.0%and filler contents of around 7-9%. The percentage of fibre that is required for SMA is 0.3% and the air voids of around 4%. The skeletal formation of the coarse aggregate provides high resistance to deformation. Adding the fibres to the SMA mix will prevent the asphalt from draining down during storage, transport and laying. Very soft binder may drain down easily. The fibre mastic fills the voids and retains the chippings in position. It has an additional stabilising effect, as well as providing the design air voids for high stability. The result is a highly durable rut resistant asphalt mix.

UPM's Stone Mastic Asphalt (SMA) is particularly recommended for high speed expressways, heavy truck lanes, ascending and descending lanes, access and exit ramps, traffic lights and stop sign areas, port areas with heavy commercial vehicles, accident prone areas due to poor skid resistance (polishing and hydroplaning), and parking lots.

SEROKINETIC MODELS OF IMMUNE RESPONSE AS BASIS FOR IMMUNISATION AND MONITORING OF POULTRY FLOCKS

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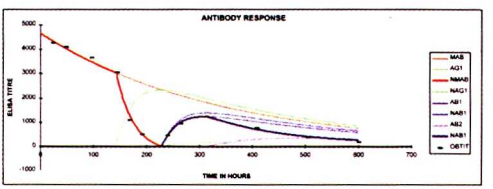
The serokinetic models aim to provide the basis for making decisions about how and when to vaccinate and monitor immune response to solve the problems of vaccination breakdowns in poultry flocks. Studies on broiler and layer flocks have shown the usefulness of the Models and the Serokinator Programme in determining the optimum time for vaccination and monitoring which hopefully would become the Poultry Industry Standards.



Problems arise because the common practice of following the recommendation of the vaccine producers using one set of vaccination programme for any farm, results in disease outbreaks. A more scientific approach to solve this problem is by the use of models - the Serokinetic Models using differential calculus and integration techniques and Laplace transforms and incorporating the basic principles of Immunology, Pathology, Epidemiology and Statistics.

These models are incorporated into a programme called SEROKINATOR in Microsoft Excel (Chulan, 1998) to determine the Serokinetic Profile (SP) of a flock based on the observed data of ELISA antibody titres taken at 2 day interval before and after vaccination (vaccination at day 6) for a period of 3 weeks. The serokinetic constants obtained from the SP are used to predict the immune response of future flocks of the same breed in a farm and thus the optimum time to vaccinate and to monitor.

The Serokinetic Analysis (SA) provides the basis for vaccine producers to market their vaccines in the local market and the farmers to choose which vaccine to use based on the SP of the flock to a vaccine especially in conjunction with Vaccine Efficacy Studies. Researchers could use the Serokinetic Model of Immune Response to design and evaluate their experiments better.

Section II - Innovative Research

Investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new findings — practical application of research leading to product development.

MAGNETORESISTIVE MATERIALS FOR MAGNETIC SENSORS APPLICATIONS

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When a metal or a semiconductor is placed in a magnetic field, its electrical resistance usually changes by a small amount and is known as magnetoresistance (MR). In 1988, Baibich discovered magnetic superlattices multilayers (Fe/Cr) with huge MR value. This effect is known as giant magnetoresistacne (GMR). Magnetoresistance effect is also observed in ceramic materials such as La-Ca-Mn-O and is much higher than that observed in alloy system. Hence the effect is termed as colossal MR or CMR.

The effect of doping on the Mn sites and the influence of the dopant on the double exchange mechanism responsible for the existence of ferromagnetism has been studied. Thin film was fabricated by depositing individual atoms on a substrate. The split target comprised a disc with magnetic and nonmagnetic sectors in proportions appropriate to the desired film composition of about 25% magnetic entity. The magnetic entity could be Co, Fe or Ni, while the non-magnetic matrix could be Cu, Cr, Ag and Au.

GMR materials:. A 25% of magnetic entity and 75% of non-magnetic matrix agrees with the results of others. Granular thin film, $Ag_{74.6}Ni_{5.3}Fe_{20.1}$, with high GMR value of 3.73% (at 1 Tesla) at room temperature has been developed, which meets the requirement in the magnetic sensors and data storage industry.

CMR bulk materials: The doping of Dy or V at Mn sites decreases the samples' ferromagnetic transition temperature, Tc and peak temperature in the resistivity- temperature curve, Tp simultaneously. Dy doping showed more drastic effect on the suppression of Tc than V doping as Dy replaces Mn3+, while V replaces Mn4+.

Today, due to improvement and new discoveries of their interesting properties, thin films are now widely used in several type of application such as electronic devices, optical coating, thin film magnetic head sensor and many others.

EFFECT OF DOPING OF VARIOUS ELEMENTS ON CALCIUM / COPPER SITES IN BI (PB)-SR-CA-CU-O AND Y-BA-CU-O HIGH TEMPERATURE SUPERCONDUCTING SYSTEMS

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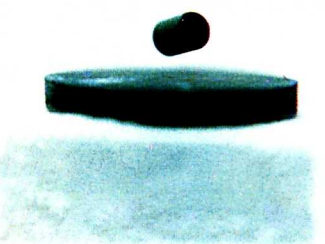
Superconductors are materials which, under certain conditions, have zero resistivity, and are perfect diamagnets There are three conditions which must be present for a superconductor to exhibit these properties: The temperature must be below the critical temperature, Tc; the magnetic field must be less than the critical magnetic field, Bc; and the current density in the superconductor must be less than the critical current density, Jc. If any of these values exceeds the respective critical value, the superconductor becomes "quenched" and loses its superconductive properties.



The discovery of ceramic superconductors by Bednorz and Muller in 1986 has ignited an explosion of interest. To date the highest Tc achieved is 130°K. Currently, research has been focussed on the effect of partial replacement (doping) of certain atomic sites in the BSCCO and YBCO systems. The influence of doping elements such as Ba, Sn, Zn, Y, V, Si, Sm, Dy, Pr, Gd and Nd, on the Ca sites has been studied for the BSCCO system and Sn, In and Dy for the YBCO system. From our study, the relationship between lattice size effect and valencies to the phase formation and hence the Tc was obtained.

The results show that all doping have decreased zero resistance with temperature. The dopants with ionic radius bigger than that of calcium showed better Tc zero. Barium doped samples are least affected by compositional variation and the Tc are much higher than that of other doped samples. The magnetic rare earth elements did not suppress superconductivity drastically as observed in samples doped with transition elements. Hence it could be deduced that 4f electrons have lesser effect than the 3d electrons on the pairing mechanism.

The high temperature superconductor transformer, 630 kVa was first demonstrated in Geneva, Switzerland in 1997. The transformer uses the superconductor's ability to transmit electricity with no resistance. We have developed a prototype school demonstration kit. An automation technique to study the magnetic levitation, as shown in the picture, has also been developed to study the influence of doping on the levitation force.

ISOLATION AND IDENTIFICATION OF AN ACTIVE ANTIMICROBIAL COMPOUND FROM *STROBILANTHES CRISPUS*

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Strobilanthes crispus (L. Bremek), popularly known as Kecibeling in Malay is a common herb in Malaysia. It has been used widely by the people in Malaysia and Indonesia to improve bowel function and to increase urine output. This plant is known to contain a number of chemicals, which may be active pharmacologically.

Our preliminary investigation has successfully isolated and identified a bioactive antibacteria compound from *Strobilanthes crispus*. Using high-field NMR spectroscopic techniques and comparison with published data, the active antibacterial compound isolated was identified to be verbascoside. This was confirmed by the presence of clear peaks, which indicate the above compound in both the ^{1}H-NMR and ^{13}C-NMR spectra. The molecular formula of this compound is $C_{29}H_{36}O_{15}$ and its molecular weight is 624.594.

The antibacterial activity of verbascoside was tested both *in-vitro* and *in-vivo*. Both the tests showed that the isolated compound was active against Gram +ve and Gram -ve bacteria used in the tests. In *in-vitro* testing using staphylococcus aureus ($2x10^7$ cells/ml), *Salmonella typi* (1.65x107 cells/ml) and *Pseudomonas aeruginosa* ($1.87x10^7$ cells/ml), the zone of inhibition for the extract containing verbascoside was significantly greater than the zone of inhibition for penicillin, tetracyline and erythromycin. Similarly, experiment carried out in mice infected with Staphylococcus aureus ($1.8x10^7$ cells/ml) and *Salmonella typi* ($2.3 x10^6$ cells/ml) showed that the compound given intraperitoneally, 38.5 mg/kg and 35.5 mg/kg respectively has prevented the death of the infected mice. All the above-infected mice which were not treated with the compound died with 48 hours post infection.

Based on our present results, the compound verbascoside isolated from Strobilanthes crispus showed a very promising new antibacterial agent, which may be very useful in treating bacterial infection. It is another contribution towards the advancement of Science in drug research and has a tremendous potential to be developed into an important and effective drug product, which can capture both the local and international pharmaceutical market.

EVALUATION OF NUCLEAR POLYHEDROSIS VIRUS (NPV) AS A BIOPESTICIDE FOR CONTROLLING S. LITURA

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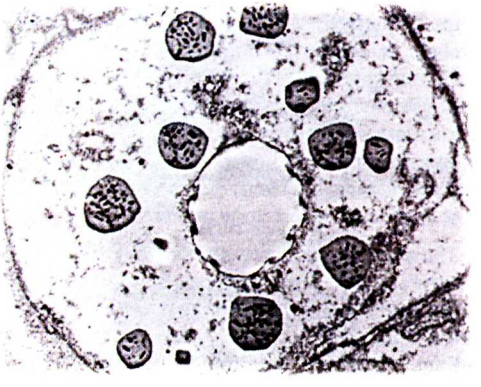

The armyworm, *Spodoptera litura* (*Lepidoptera: Noctuidae*) is a serious pest of many vegetable crops and tree crops in nurseries. In an effort to find an alternative mean of controlling the armyworms to chemicals, we conducted a survey for natural enemies associated with this insect pest. During our survey, we managed to isolate a baculovirus, nuclear polyhedrosis virus, infected armyworms attacking tobacco in a farm at Telong, Kelantan. The virus was propagated in the laboratory using armyworm larvae. From this tock, several experiments were carried out. Through SEM and TEM, we found the NPV was typically polyhedral shaped between 1.5-2.25 µm and embedded with multi-virions, 7-32 virions/polyhedron. The virus was very pathogenic to its host larvae. It could cause 100% mortality to second instar within 3-7days when they were exposed to different virus concentrations. It was not pathogenic to a generalist predator such as Sycanus leucomesus. The virus was very infective at pH 7 but it was adversely affected at pH 11. UV light, however, was a limiting factor when the virus was exposed to the environment. It was more vulnerable to UV-B and UV-C than UV-A. The virus could also be inactivated when it was exposed to sunlight for 12 hours. Deleterious effects of the UVs, however, could reduced with and addition of 1% Tinopal, an optical brightener, to the virus. Based upon results form laboratory experiments, we conducted a small scale field experiment using formulated virus preparations. Virus preparations were sprayed on to Brassica juncea (sawi bunga) that have been infested with S. litura larvae. The result shows that the virus could protect the sawi from damages caused by the armyworms. No significant differences in yield between Brassica treated with virus+tinopal compared with that of sawi treated with Nurelle®, an insecticide recommended for Brassica. The result from the project clearly shows that NPV has the potential to be developed as a biopesticide for armyworm and has a place in an integrated pest management program.

THE INTERFACE OF WORK AND FAMILY ROLES OF PARENTS IN DUAL-CAREER FAMILIES

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This study was conducted on four groups of married working women (researchers, secretaries, nurses and factory production-operators) and their husbands. Women meeting the following criteria were selected: (1) married, (2) working full-time, (3) living with husband who is working full-time, and (4) has at least one child staying at home.

Picture not available at time of print

The study found that working parents experienced varying intensities of conflict in trying to meet the demands of work and family roles. Among nurses, work interfered with family life more than family life interfered with work life, indicating that family boundaries were more permeable than work boundaries. However, there was no evidence of parental or gender differences in the permeability of work and family boundaries. Among factory production-operators, the intensity of conflict experienced reduced with increased level of satisfaction with childcare arrangement. Only one-third of the operators indicated that they intended to continue working upon having another child, considering the rising cost of childcare services. In managing work-family conflict, women tended to cope through reactive role behaviour, and personal role redefinition. These two strategies were more frequently adopted than the structural role redefinition. The women in this study received social support at the work place and outside the work place. They received the least support from their supervisors, and the most from their husbands. Higher intensities of work-family conflict experienced by secretaries significantly led to lower levels of job and family satisfaction. Lower levels of both job and family satisfaction, in turn, significantly led to reduced levels of life satisfaction.

The findings have implications on planning and formulation of human resource policies aimed at improving the employee well-being, job satisfaction, family satisfaction, job performance and productivity, social support and facilities, and overall quality of life.

LARGE SCALE PRODUCTION OF KOJIC ACID

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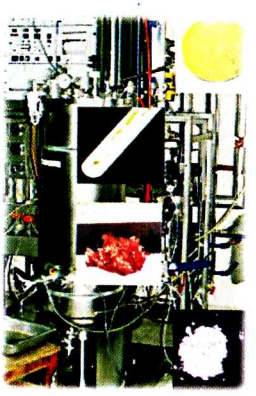

Kojic acid (5-hydroxy-2-hydroxymethyl-γ-pyrone) has several industrial applications. It is widely used in medicine as an anti-inflammatory drug and painkiller. Kojic acid is also used as a precursor for flavor enhancers and as an antibrowning agent in the food industry. In the cosmetic industry, kojic acid is used as a whitening agent. The applications of kojic acid are increasing enormously with a growing presence in the industries related to its usage as mentioned above. The market price of industrial grade kojic acid is ranging from RM2,500-00 to RM5,000-00 per kg depending on its quality. The price of laboratory grade kojic acid is between RM11,000-00 to RM19,000-00 per kg.

At present, there are only a few compnies throughout the world that have capability to produce commercial kojic acid. In our research and development program, two superior kojic acid-producing strains belonging to *Aspergillus spp* have been isolated. The strains were identified and coded as *Aspegillus flavus* Link 44-1 and *Aspergillus flavus* S33-2. The screening and isolation program involved more than 1000 strains collected from different sources. Microbiological approach, which involved mutation and monospores isolation technique, has been applied to the isolated strains for improvement of kojic acid production.

Optimal and economical medium for growth of the strains and kojic acid production, in terms of maximum concentration, yield and overall productivity has been formulated. The fermentation technique that is capable economic production of kojic acid has been developed. The biochemistry and microbiology aspects of kojic acid fermentation by *A. flavus* have been intensively studied and several papers have been published in an international journal. The engineering approach has also been used for the improvement of kojic acid fermentation by *A. flavus*. This includes development of aeration and pH control strategies in batch submerged fermentation and most of the findings are novel. Our research group has also developed recrystallization technique to purify kojic acid from the fermentation broth. By using this technique, very high purity (99.9%) kojic acid crystals could be obtained at very low cost.

GOAT'S MILK: ANTIOXIDANT ACTIVITY AND ITS EFFECT DURING LIVER CANCER

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Picture not available at time of print

Milk is well known for its nutrition value and is believed to have therapeutic properties. Realizsing its benefits to human, this preliminary study has been conducted with the aim of determining the antioxidant activity and the potential anticancer effects of goat's milk during hepatocarcino-genesis.

The antioxidant activity for both crude methanolcrude methanol and water extract were tested using the ferric thiocyanate (FTC) and the thiobarbituric acid (TBA) method. Using FTC method, the results showed that methanol extracted samples have higher antioxidant activity compared to the water extracted samples. The interesting is that the total antioxidant activity of goat's milk is higher than cow's milk.

The effects of goat's milk administration on hepatocarcino-genesis in rats induced by diethylnitrosamine (DEN) and acetyl-aminofluorene (AAF) were investigated by determining gamma-glutamyl transpeptidase (GGT) and alkaline phosphatase (ALP) activities in blood. Twenty-four Sprague-Dawley rats were divided into 4 groups: control, DEN/AAF, goat's milk (5 ml/day) and DEN/AAF with goat's milk treatment. The rats were sacrificed after 8 weeks. The blood was collected. Treatment with DEN/AAF increased ALP and GGT levels significantly ($p<0.05$) but decrease significantly after goat's milk administration ($p<0.05$). Histological and TEM observation indicated some recovery of carcinoma cell. Again, cellular damage of carcinoma cell becomes normal after the administration.

The results showed that goat's milk worked effectively as an anticarcinogenesis agent. It could become an alternative or treatment together with chemotherapy for cancer patients although further studies are required. The data from this research can be used to initiate further study particularly in the purification of goat's milk to investigate the active component for its anticancer properties. Apart from its good nutritional and medicinal value, goat's milk is a natural product that will not induce any side effects to the consumer. Hence new products from goat's milk could be promoted to be use as a cancer prevention source in Malaysia rather than using other artificial medication and it should be commercialized to the public.

IMMUNE MODULATING ACTIVITY OF AN AQUEOUS EXTRACT FROM *SOLANUM TORVUM*

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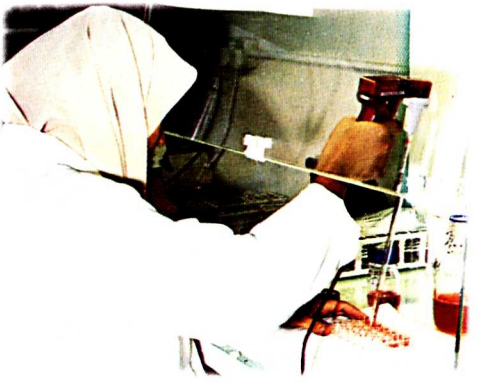

Manipulation of the immune system to achieve protection against infectious disease has been practised over centuries.. The immune system comprises two types of immunity: innate and specific. Both types of immunity function in concert however they differ in many ways. The innate immune system is the first line of defense, it occurs rapidly and is dominated by cells that can recognise and kill any foreign agent. The specific immune system is dominated by lymphocytes, a type of white blood cell, and requires sensitisation by specific stimuli before activation. It is latter type of immunity that was demonstrated by Jenner through his pioneering work in which infections with the smallpox virus were eliminated following immunisation with a less aggressive form of the virus.

Over the years, scientists have searched for substances that can enhance innate and specific immunity. Substances from man, animals, bacteria, yeast and fungi have been used as immunomodulators or biological response modifiers. The use of natural plant products as immunomodulators is relatively new with saponins and glucans showing promising results.

Of several indigenous medicinal plant species screened for immunomodulatory activity, we have demonstrated that aqueous extracts from Solanum torvum possess immunomodulatory activity at extremely low doses when applied to lymphocyte cultures and administered both parenterally and orally in protein immunisation models. Using biotechnological methodology, it has been shown that the extract alters the synthesis of cytokines (regulatory molecules of the immune system). Research now in progress focuses on purifying and characterising the active compounds for the development of immunomodulators for the prevention of infectious disease and cancer in both man and animals.

CONTROLLED-RELEASE FORMULATION OF HERBICIDE

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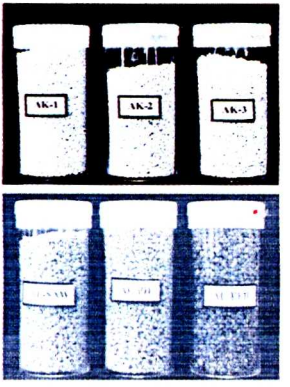

Most pesticides fail to reach their target and cause detrimental side effect on the environment. An alternative is the use controlled-release formulation (CRF) technology. CRF traps pesticide in a matrix and releases over time at a predetermined rate. The trapped pesticide is not only protected against losses by physical, chemical and microbial processes but also effective for a longer period of time.

Controlled-release formulations of diuron were prepared in the laboratory using the concept of physical matrix utilising sodium alginate and kaolin. Chemical assay showed that the formulation having a 1:1 ratio of alginate to kaolin with 1mm granule size release diuron faster than the 2 mm granules. The maximum release of diuron from the formulations was at 30 days. The CRFs of diuron using sawdust (SAW), oil palm empty fruit bunch (EFB) and paddy husk (PDH) as a substitute of kaolin, showed that 90% of the diuron was successfully incorporated in these formulations. Also similar rates of release were obtained when compared with the alginate kaolin based CRFs. Bioassays using *Brassica rapa* seedlings as bioindicator showed slower initial release of the CRFs compared with the conventional formulation, but three weeks later, mortality of the seedlings between the conventional formulation and CRFs was not significantly different. However, at 16 weeks, CRFs performed better than the conventional formulation. At 24 weeks, results were similar with higher mortality rate with CRFs (40 and 70%) than with conventional formulation (6%). The biological efficacy of the CRFs and conventional formulation against *Paspalum conjugatum* and *Diodia ocimifolia*, showed no significant difference in mortality between the formulations at 1 month after treatment (MAT). However, significantly higher seedling mortality was observed with the controlled-release formulations, except the PDH formulation at 2 MAT. The CRFs gave 60-85% mortality compared to 40% shown by the conventional formulation. The CRF has the potential for commercialisation as the formulation reduces the frequency of application, increase the efficacy of utilisation of toxicant and environmental friendly. Further improvements on the CRF are planned particularly on the initial release rates.

SYNTHESIS OF NON-TOXIC PALM GLUCOSE FATTY ESTERS VIA SOLVENT-FREE INTERESTERIFICATION REACTION

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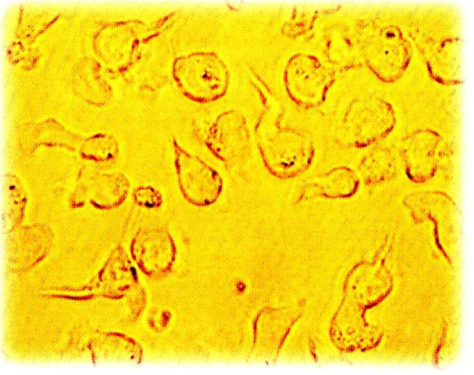

Carbohydrate esters of fatty acids are nonionic surfactants, which now attract attention from the cosmetics, pharmaceutical, and nutrition scientists because of their multi-functional properties and safety. They are nontoxic, odorless, tasteless and biodegradable. The potential applications of carbohydrate esters have however been greatly hindered by the use of toxic solvents during synthesis and processing. The numerous methods developed, so far, for the acylation of these polyhydroxylic systems are still faced with two fundamental problems: (i) finding a nontoxic mutual solvent for both the fatty acids and carbohydrates, and (ii) avoiding carameliszation of the carbohydrate at reaction temperatures. Complex and expensive manufacturing processes are currently employed in producing commercial mono- and disaccharide fatty esters.

In this workstudy, a solvent-free, low temperature, chemical interesterification method, yielding up to 90% product was developed. The products are mainly mono- and di-fatty acid substituted acetylated glucopyranoses. This process has the following advantages of: (; 1) . A single-step solvent-free reaction process which, which avoids the usual tedious multi-step procedure of acylation; (2) t. The low temperature requirement for this process reduces the risks of degradation and denaturing of reactants and reduces energy cost; (3) t. The reaction products, mono- and di-fatty acetylated glucose esters, are potential emulsifiers; and (. 4). Bbiological assessments have shown the products to be nontoxic to human and animal cells, rather, they are antimicrobial, albeit mild.

The synthesis method developed in this study is not complicated and, thus, cheaper. The process is high-yieldinghigh yielding, thus, commercially viable. Raw materials (vegetable oils and glucose) are natural and renewable. This process is therefore both environmental and consumer friendly. The products are free from solvent-residues. Products can therefore be used in food and pharmaceutical formulations.

THE INTERMEDIATE HOST OF *CRUORICOLA LATES*

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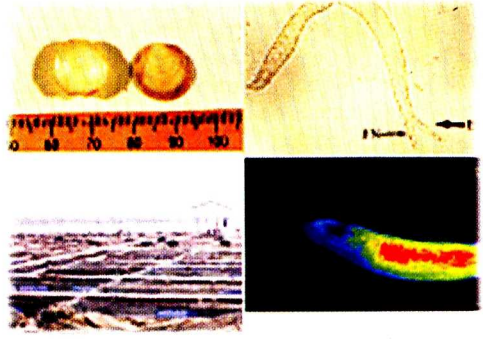
This study was carried out from 1996 to 1998 to investigate the intermediate host of the marine blood trematode Cruoricola lates, a new genus and species from Malaysian seabass Lates calcarifer. This adult parasite, a digenetic trematode, is found in the heart and mesenteric blood vessels of the fish. The parasite lays ovoid eggs in the kidneys and gills. The eggs hatch into miracidium, which will then infect the intermediate host, probably, an invertebrate. Hence the invertebrates in the soil surrounding cage culture sites had to be examined for presence of sporocysts and cercaria.



The Ekman grab was used to grab soil samples from the bottom sediment below cages where seabass were held. These cage culture sites were located in Selangor; Terengganu; Kelantan; Pulau Pinang, and Perak. The soil samples were sifted and marine molluscs collected and examined for sporocysts and cercarial stages of digenetic blood trematode. Eventually in 1998 the sporocyst were found in the larva of the marine bivalve Lucinidae, Anodontia edentula. This sporocyst had forked-tailed cercaria conforming that it was larva of digenetic trematode. Water quality investigations showed a strong relationship between high salinity areas and the presence of blood trematodes. The presence of numerous empty A. edentula shells at the cage culture sites indicates mortality of A. edentula after mass exodus of cercaria from sporocysts in the marine bivalve. At present, heavy infection rate, which would adversely affect seabass, production rates have not been observed. However probable sublethal effects of Cruoricola lates infection on sea bass are reduce food conversion ratios and increased susceptibility to disease. The knowledge of the life cycle of the parasite will lead to implementation of management practices to minimise infection rates and increased productivity. This study has shown that marine bivalve Anodontia edentula is intermediate host of the blood fluke Cruoricola lates, therefore new infection can be prevented by elimination of these bivalves from the cage culture sites. This is the first report in tropical marine parasitology that a marine bivalve is the intermediate host of a marine blood fluke.

TRICHODERMA HARZIANUM, A PROMISING BIOFUNGICDE FOR THE CONTROL OF BASAL STEM ROT OF OIL PALMS

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Fungi are second only to plants as a source of natural products in the pharmaceutical industry, but presents a relatively new bioresource in the chemically-dominated agriculturally based sectors. This study was focussed on the use of a soil microbe in place of chemicals that could suppress the growth of *Ganoderma boninense*, a fungus that causes 'basal stem rot', a disease characterised by the rotting of the internal tissues of the palm. Chemical trials carried out thus far have met with very limited success and the disease persists slowly but surely.

The isolation of microbes from soils in infected oil palm habitats consistently showed that the highest population of microfungi belonged to the genus Trichoderma. Thus, as many Trichoderma units were isolated and screened for their ability to inhibit growth of *G. boninense* on culture plates. Results showed that isolate BIO T32, of the species *Trichoderma harzianum*, performed most successfully as an antagonist of the pathogen.

Subsequent trials were conducted using artificially infected oil palm seedlings planted in pots placed under greenhouse conditions. The overall results of greenhouse trials showed that the mode of delivery and timing of application were important factors to be considered in the treatment procedures.

Success with pot trials provided a stepping stone towards future trials and implementation in fields. The use of home-grown fungal antagonists have several value-added advantages over use of chemicals. The biological product is self-perpetuating in the soil and acts specifically against the target organism. Besides providing oil palm growers with an alternative product for use in disease management, the industry stands to benefit from its environmentally-friendly nature. The bioproduct is not likely to induce the 3R's that result from use of agrochemicals, namely Resistance in target plants, Residues left over from chemicals and Resurgence of a more aggressive strain of pathogen. Clearly, Trichoderma-based product is the biofungicide of the future. The potential for its commercialisation is immense.

A NEW GROWTH MEDIUM FOR PURE ALGAL CULTURE

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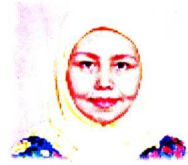

Microalgae are very important commodities for aquaculture, food, pharmaceutical and cosmetic industries. Economical methods for growing commercial algal species are being pursued to decrease the production cost. Normally inorganic media consisting between 12-14 different chemicals are used to make culture media for culturing pure algal stocks. These media are relatively expensive, especially when they have to be used in large amount such as in fish/shrimp hatcheries.

Interstitial water extracted from aquaculture pond bottom sediments offers an alternative media for culturing different pure algal species. It is rich in phosphorus, nitrogen, silica, essential amino acids, polyunsaturated fatty acids, essential minerals and micronutrients required for healthy growth of various algal species. The nutrients in interstitial water need to be diluted 10-20 before used as growth medium. Preparation of this medium involves centrifuging the sediments to extract the interstitial water and sterilising the media by exposing to ultra-violet light.

Experiments showed growth of a marine diatom, *Chaetoceros calcitrans*, blue-green algae, Oscillatoria sp., and green algae, *Nannochloropsis oculata* cultured in diluted interstitial water was significantly higher ($p < 0.05$) than the Conway medium (normally used for culturing marine algae). Further bioassays have demonstrated that diluted interstitial water was the best medium for culturing pure stocks of marine algae. In addition, algae cultured in this new medium have higher contents of essential amino acids and polyunsaturated fatty acids compared to those grown in Conway medium.

Thus interstitial water can be used to mass culture a single species of algae without contamination. Concentrated sterilised interstitial water can be bottled and packed with pure algal inoculum. Algal culture can easily be initiated by diluting the medium in transparent container such as plastic bags and inoculate the algal cells. On exposure of the plastic bags to sunlight, algal culture will develop profusely within a few days and can be used for various purposes such as feeding fish/shrimp larvae or extraction of bioactive compounds.

EFFECTS AND MODES OF ACTION OF *LACTOBACILLUS* AS A PROBIOTIC FOR BROILER CHICKENS

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During the past two decades, probiotics (direct-fed microbials) which include *Lactobacillus* cultures, have been used as an alternative to antibiotics in animal production. Although imported commercial probiotics are available in Malaysia, inconsistent results have prevented their use in poultry production. Therefore, a series of experiments was conducted at the Institute of Bioscience, Universiti Putra Malaysia, to isolate and characterise suitable local *Lactobacillus* strains for use as a probiotic for broiler chickens.

Chickens fed a mixture of the 12 *Lactobacillus* strains grew more rapidly, consumed less feed, had lower mortality rate, less pathogenic bacteria such as *E. coli* and *Salmonella* in their gastrointestinal tract, less body fat and less cholesterol in their blood serum than chickens fed without *Lactobacillus*: Since a *Lactobacillus*-fed chicken grows rapidly and consumes less feed, the cost of production is lowered. Savings from feed (calculated from improved feed conversion of 0.26 units), and profit of premium price of antibiotic-free chicken (calculated at 10% above farm-gate chicken price of RM 3/kg for 1 million 2kg chickens produced daily) are estimated to be about RM382 million per annum.

Our research has dispelled previous uncertainties and scepticism concerning *Lactobacillus* as a probiotic for poultry. A mixture of 12 *Lactobacillus* strains supplemented to broilers significantly improved growth performance and feed conversion ratio in broilers. Thus, our research confirms that the *Lactobacillus* strains have the commercial potential to improve growth and feed efficiency. Currently, efforts are in progress to scale-up the production and mass culture of the *Lactobacillus* strains in bioreactors using cheaper local media for field trials and commercial application. The Malaysian Technology Development Corporation is seeking a joint-venture partner for commercialising the product once the scaling-up production has been achieved. With increasing demand by consumers for safe food, it is timely that Malaysia takes the lead in revolutionising poultry production by using UPM's "Green Technology" to produce antibiotic-free chickens.

BIOLOGY AND CONTROL OF *POMACEA* SP., SNAIL PEST OF RICE PLANT

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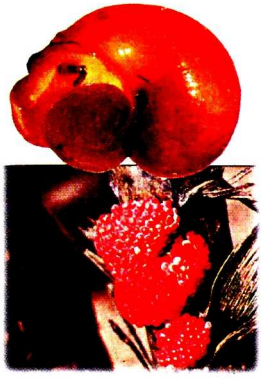

Currently the snails *Pomacea canaliculata* and *P. insularus* have been found in ponds, lakes, streams, river and rice fields not only in Peninsular Malaysia but also in Sabah and Sarawak. Because of their voracious feeding habits he snails causing great damage mostly young rice plants and. During drought season, the snails burrow into the mud and stay inactive for months; they are active during the rainy season.

Although various control methods had shown some impact on the snail-population, it still poses serious threat to rice production in Malaysia. At the Department of Biology, we have integrated several contro methods by including chemical control (using locally produced natural molluscicide), biological control by predator fishes and utilization of snail meal for the feed of animals such as Japanese quails.

Of about 60 local plants screened, we have have isolated a common ornamental plant that is effective as molluscicide. Another possibility is the use of suitable fish as the biological control. By carefully time the release and choosing the proper size of the fishes, the snails can be effectively reduced. The cultured fish can then be harvested at the end of the growing season. Thus it can be a supplementary source of income to the farmers. *Pomacea* can also be utilized as the protein supplement in the ration of quails.

There are many commercial opportunities from this project. Firstly, the molluscicide is a viable product considering the area of infestation is expanding and there is actually very limited choice of molluscicides in the market. Production of snail mealfrom *Pomacea* can be considered as a way to reducing the import of protein animal feed. Lastly, we have the expertise and services on culturing fishes in rice fields.

SPATIAL DISTRIBUTION OF WATER TURBIDITY IN SEMENYIH AND LANGAT DAM USING SATELLITE REMOTE SENSING TECHNIQUE

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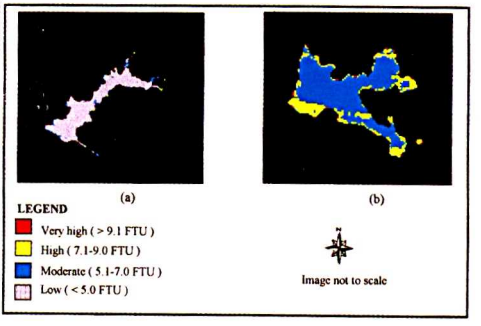
The water supply and its quality would be a worrying situation in the region where there are urban, industrial and agriculture development. Lack of proper planning in land use especially in the forest watersheds and catchment may lead to the problem of insufficient water supply to the nation. One of the major water supplies concerns facing the general public in Peninsular Malaysia, especially Selangor and Kuala Lumpur is the occurrence of water recession episode. The water recession that occurred in the 1997 and 1998, was the worst to hit the country.



Landsat TM is useful and providing spatial information in the analysis of the current land use trend in catchment area. Remote sensing data can identify and quantify forest cover depletion surrounding the watershed routinely. Moreover, the active Landsat TM is also appropriate to determine the causes and factors influencing water quality and water regime. Landsat TM may be used in watershed management system to help identify watershed condition and also to predict potential problems associated with various land use activities such as forest harvesting, including how these activities will alter the landscape or how river and streams will be impact by changes in forest land cover in drainage basin.

Satellite data provided by Landsat TM instruments allow researchers to assess and estimate water quality with advance image processing technique. A huge sediment load represent major threat to the pollution, and these factors can be also be monitored directly from space. The application of density slicing and contrast stretching techniques to the water portions is promising and showed discrete turbidity ranges coded by grey level or color. It can be concluded that satellite remote sensing technique can be used as a predictive tool for managing water resources in watershed especially, in spatial mapping of water turbidity level in big dams and associated water ponds.

TIMBER VOLUME ESTIMATION IN GUNUNG STONG FOREST RESERVE USING SATELLITE REMOTE SENSING TECHNOLOGY

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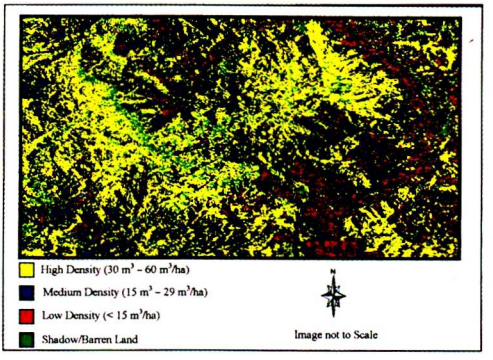

Management of various economic aspects of forest is characterized by long production intervals. Consequently sound long-term planning is required, for which detailed forest maps and inventories are vital. In the course of preparation of forest maps and inventories, forested areas are divided into homogenous units (strata). Recent forest conditions in the strata are described in detailed, and future management activities planned. In countries where forest management is less extensive, the inventories are often based on surveys of randomly sampled areas resulting in accurate statistics of tree species distribution, timber volume and quality. This practice, however, is time-consuming and costly, and does not support the production of adequate forest maps. Satellite remote sensing helps by providing a synoptic view of large region and by displaying forest patterns. Forest mapping by remote sensing methods can be complemented by detailed ground survey; thus both accurate statistics and thematic maps can be obtained. By applying remote sensing techniques, timber volume and forest stand structure data can be successfully analyzed with the combined of additional ground data. The final output of remote sensing supported inventories is image maps and statistics, reliably documenting up-to-date documentation of forest conditions.

INTEGRATED REMOTE SENSING-GIS FOR EROSION RISK ASSESSMENT IN THE HIGHLAND USING LANDSAT TM: THE CASE OF GENTING HIGHLAND, MALAYSIA

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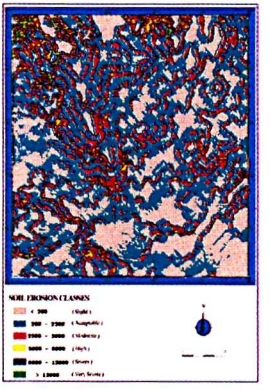

There is a general awareness of soil erosion as a problem in Peninsular Malaysia, as evident by the widespread use of bench terracing and ground cover as mitigating and conservation measures in plantations as well as along highways. Satellite images are capable of providing critical and timely information for effective conservation as well as sound management systems and strategies. The capability of integrating remotely sensed data with, or into Geographic Information Systems (GIS) further provide a critical component in enhancing and strengthening the whole development of particular management system. This study done on Genting Highlands is to evaluate the applicability of integrating Landsat satellite imagery with GIS in soil erosion risk assessments of highlands

This study may be divided into two main components, remote sensing and GIS. The remote sensing component consists of a LANDSAT 5 Thematic Mapper (TM) image which was acquired on 21st. February 1991. This imagery provided information on vegetation cover and type. The GIS component, meanwhile, consisted of a digital topography map which was created from 1993's mapsheet at a scale of 1:50 000. Apart from this, other GIS data included a 20-year averaged rainfall map and soil type, erosivity and degree of slopes. The Micro Computer-based Spatial Information System (MICSIS) software was used in image analysis as well as computation work. The output was first, a "current erosion risk map", depicting the level of susceptibility to erosion based on existing landuse cover as well as use, and the other environmental parameters. Another map, the "potential erosion risk map", was generated by assuming the forested areas were reduced by 50%. This map indicated that areas most prone to severe erosion are those currently cleared of vegetation and those sparsely vegetated. The applicability of such a system is that the generated maps give ideas to planners as well as developers to plan for mitigating as well as conservation measures, and areas to be avoided if land works of similar intensity is to be carried out.

DEVELOPING SOIL NUTRIENT VARIABILITY USING PRECISION AGRICULTURE

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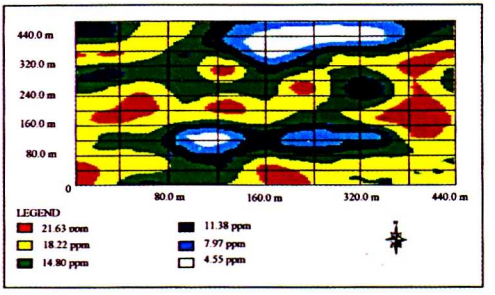
Precision agriculture technology has been claimed to serve as a tool for crop production management, especially in production input resource evaluation. The lack of knowledge about soil nutrient properties and variability has led paddy farmers and range managers to a non-systematic fertiliser application practice. As a result, the paddy and pasture farm areas are probably over-fertilised and the use of the allocated subsidised fertilisers has not been fully optimised.



Our technology can predict future crop yield with optimum fertilizer input. LANDSAT Thematic Mapper data (path/row 128/56) integrated with GIS and GPS (Trimble GeoExplorer™ II) was taken on 27 February 1997. Digital data processing and analysis was performed using a PC-base PCI EASI/PACE Version 6.2. Other auxiliary data includes: Topographic map (Department of Survey and Mapping Malaysia); land use cover map (Department of Agriculture, Malaysia); soil series maps (MADA, Kedah, KADA, Kelantan and UPM); and semi-detailed soil maps (MADA, Kedah, KADA, Kelantan and UPM).

A systematic soil sampling was conducted and geostatistic analysis was performed to produce the soil nutrient variability maps for UPM and KADA paddy areas in Kelantan. By integrating with the individual soil nutrient maps produced by Geostatistic Program, GIS, database management and GPS, a current status of soil nutrient variability map (N, P, K) can be generated for further analysis by the field and crop experts.

Using Precision Agriculture System based technology, precise estimation and future yield prediction is much easier, which was traditionally done by endless inventories, inaccurate randomized soil sampling and field survey that consume longer time. Farmers can now use these maps as a guide to fertilizer requirements of their fields and thereby save government's fertilizer subsidies. Yield can also be predicted based on the map produced. Besides fertilizer management, these technologies can be applied for pest or disease management or even weed management.

MONITORING AND QUANTIFYING DEFORESTATION IN PERMANENT FOREST RESERVE (PFR) USING REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM: A CASE STUDY IN KELANTAN

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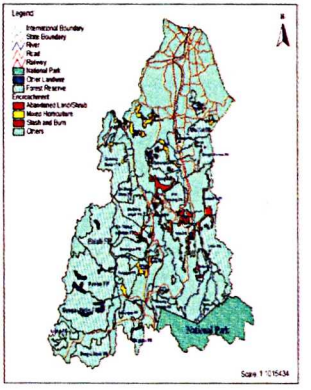

Many ecosystems are subjected to increased degradation in one way or another by encroachment from man. In the case of tropical humid forest, it is rapidly disappearing due to many causes especially conversion to agriculture, settlements, and industrial development. Lately, to some extent much of the forestlands were degraded. The major causes of forestlands degradation are fairly well understood. The main concerned here are those areas within the Permanent Forest Reserve (PFR), which had been converted for agriculture and another land use.

This study highlighted several approaches of solving forest encroachment and one of the attempts is to monitor the rate of deforestation in Kelantan, Malaysia. Integrating remote sensing and GIS analysis will aid government by providing useful and vital information to minimize and monitor deforestation. This technique is able to store, retrieve, analysis and display data both on spatial and tabular in a simple and comprehensive manner. It can display the distribution of deforestation as well as the type of forest encroachment and at the same time giving information and description about the area, size, location, year of the forest encroached and others. Also the physical factors such as access roads and rivers, which form the causal factors of deforestation, can be defined using this technique.

NUTRITIONAL AND HEALTH ASSESSMENT OF MAJOR FUNCTIONAL GROUPS IN PENINSULAR MALAYSIA

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This study, in collaboration with the Ministry of Health Malaysia (Institute for Medical Research and Division of Family Health Development), was undertaken in 1992-95 to assess the health and nutritional status of the major functional or occupational population groups in rural areas. The study locations were selected based on census data. The villages and estates were selected by a multistage sampling technique to represent rice farming, rubber smallholding, coconut smallholding, fishing and estates communities. Included in the study were 69 villages and seven estates located in nine states in Peninsular Malaysia. A total of 4,055 households were interviewed for information including household socio-economic status, infant feeding practices, and health status of children, pregnant women, mothers and older adults. Children (4,799) and adults (4,595) were measured for height/length, weight, arm circumference, waist and hip circumference while blood determinations of haemoglobin, total cholesterol and glucose were also done.

The main findings of the study were: (i) Underweight and stunting among the children in the 1-6 years age group; (ii) Problem of overweight in men (30.0-49.9 years; 31.1%) and women (40.0-49.9 years; (50.6%); (iii) Evidence of high risk of central obesity among elderly women as indicated by waist-hip ratio exceeding 0.85 (22.5%); (iv) Persistence of high prevalence of anaemia in primary school-age children, the elderly and adult women (25% averagely); (v) Prevalence of "high risk" of hypercholesterolemia (≥240mg/dl) in men (11.6%) and women (16.0%); (vi) the current mean TC level appears to have shifted 15 mg/dl higher in adults from rural communities; (vii) Hypertension (systolic blood pressure ≥140 mmHg) identified in adults aged 40 years and above namely, 33.6% in men and 34.9% in women.

Health intervention should be sensitive to the presence of the dual forms of malnutrition namely, as risk factors of cardiovascular disease and under-nutrition in the same type of community and often even in the same households.

PREPARATION AND CHARACTERIZATION OF NEW OXIDE ION CONDUCTORS

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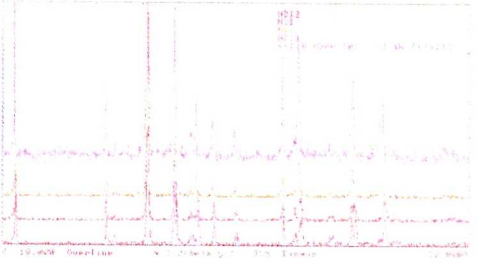
A new family of oxide ion conductors based on bismuth vanadate ($Bi_4V_2O_{11}$) exists in three polymorphic forms, α, β and γ. In our earlier studies, introduction of tetra-, tri- and di- valent cations stabilised the high temperature high oxide ion conducting γ phase to room temperature. However, the doping mechanism was not clearly understood. We have further investigated the bismuth vanadate systems using different dopants.



New bismuth vanadate solid electrolytes were synthesised and characterised using various techniques including X-ray diffraction, electron probe microanalysis, scanning electron microscopy and energy dispersive microanalysis, differential thermal analysis and ac impedance spectroscopy.

Phase diagrams of the new materials resulted by introduction of trivalent and rare-earth elements such as B, Al, Cr, Y, La, Yb, Er, Nd and Gd, tetravalent cations Si and Sn and monovalent cations Li, Na and K were studied. Solid solution areas varied in sizes and directions depending on the dopants involved, indicating different extent and mechanisms of solid solution formation. The main mechanisms appeared to be MV , MB i and BiV. The rare-earth doped materials had very similar solid solution areas and the doping mechanism appeared to be primarily M V. Both β and γ polymorphs have been prepared, depending on material compositions. K failed to form a solid solution in the bismuth vanadate system, probably due to its larger size compared to V. Confusions on the phase identity and stoichiometry of the alkali metal systems were sorted out after detailed electron probe microanalysis .

Conduction in these materials was purely or predominantly ionic. Rare-earth doped materials (β phase) demonstrated good reversibility in their conductivity vs temperature behaviour. Their conductivities (10^{-4} $ohm^{-1}cm^{-1}$ at 300°C) are one order of magnitude higher than the zirconia-based electrolyte materials. Besides, their reversibility and stability upon cycling renders them very useful materials in actual application. These could, therefore, be potential candidates for commercialisation as electrolytes for solid oxide fuel cells.

PATHOGENICITY AND IMMUNIZATION OF INFECTIOUS BURSAL DISEASE IN POULTRY

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Infectious bursal disease (IBD) in chickens due to highly pathogenic strain of IBD virus (IBDV) first reported in Malaysia in 1991, causes significant economic losses due to high mortality, excessive carcass condemnation and high cost for the control and prevention of the disease. Furthermore, the virus can cause immunosuppression in chickens, leading to high susceptibility of the infected chickens to other diseases. The control and prevention of the disease can only be successfully achieved through proper bio-security and vaccination programme.

Recently, a safe and effective live attenuated IBD vaccine prepared in embryonated chicken eggs from a Malaysian isolate of IBDV identified as UPM 93273 has been developed. The vaccine proved to be highly immunogenic and able to neutralize high level of IBD maternally derived antibody (MDA). The double vaccinations at 14 and 28 days of age provide a better protection than a single inoculation at 14 days of age.

The UPM 93273 IBD vaccine can also used for in-ovo vaccination or as a food-based vaccine. In-ovo vaccination is donein 18-day old embryonated broiler eggs, at the time when eggs are routinely transferred to hatching tray. In-ovo vaccination, is a new concept of vaccination that could eliminate post hatching vaccination, reduce vaccination stress and decrease the need of manpower. Currently, studies of the vaccine (UPM 93273) as a food-based vaccine in broiler chickens are promising in village chickens.

The UPM 93273 IBD vaccine has a high potential for commercialization and a Malaysian vaccine company has agreed to produce it commercially. A marketing study for the vaccine indicated a annual profit of at least RM 500,000.00, starting from the second year of operation. Even if the UPM 93273 IBD vaccine is only able to secure a 10% market share and selling at about 60% to 80%, it cheaper than the commercially available imported IBD vaccines.

PALM KERNEL CAKE IN AN INTENSIVE RUMINANT PRODUCTION SYSTEM

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Palm kernel cake (PKC) is a by-product of oil palm industry with high nutritive values and can be used as basal diet in ruminants. However, the high copper contents in PKC can cause toxicity, especially when fed in sheep. Goats, cattle, buffaloes can tolerate the toxic effect of copper in PKC, although the hepatic copper content in the PKC fed animals were significantly elevated. This is of public health importance as liver and other visceral organs are commonly used for human consumption. Furthermore, chronic copper toxicity may occur after long used of the diet.

A safe PKC diet fed solely in sheep as the animal model was successfully produced previously. The diet provided full protection against copper toxicity in sheep and reduced hepatic copper accumulation.. Appropriate amounts of zinc, mineral salts, vitamins and feed additive were added in the diet prior to feeding. This new PKC product is not only safe, but it is also economic, convenient to be used and can improve growth performance of animals for commercial utilization. A body weight of 30 kg was achieved within 12 to 20 weeks of feeding trial with average daily gain of 174.1+9.6g and feed conversion ratio of 4.9+0.4. Neither mortality nor gross and remarkable histological lesions were observed in the animals fed with the diet.

The new PKC diet can also be used for other ruminants. It will replace the usage of corn, fish meal and grass in the ruminant and reduce the importation of corn and fish meal and land for animals grazing.. This product has a high potential for commercialization with a very minimal additional cost to PKC.

USE OF ADVANCED TECHNOLOGIES TO DEVELOP QUALITY BANANAS

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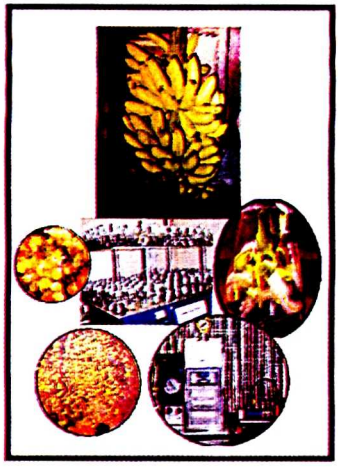

Banana is one of the most popular fruits in this country and is available throughout the year. Of all the fresh fruit, banana has: (1) Highest potassium content which is essential for the healthy functioning of the nervous system; (2) highest level of vitamin B6 which is necessary for the normal brain function and the proper development of the immune system; (3) highest level of starch and dietary fibre, that can prevent colon cancer and breast cancer, (4) high level of B2 (riboflavin), which helps in the body breakdown of carbohydrates, fats and protein; (5) high niacin content; (6) is good source of B1 (thiamin); and (7) B12 which is normally found in animal protein foods such as milk and eggs.

The major constraints of banana production are abiotic and biotic stresses. Factor such as acidity, drought, flooding and salinity often result in micro and macro nutrient imbalances, inferior agronomic characters, low yield performances, physiological disorders and susceptibility to diseases. Therefore, there is an urgent need to conduct research to ensure food productivity enhancement and sustainability. The uses of in vitro technology and molecular techniques have great potential for improvement of banana, particularly for obtaining plants with tolerance to stresses.

The banana researchers of UPM have formulated the following strategies to develop superior banana cultivars suitable for local and export market: (1) Selection and introduction of superior, existing cultivar from germplasm collections; (2) introduction of new clones which have value-added properties and tolerant to diseases; and (3) introduction of genetically engineered plants.

ANTI CANCER EFFECTS OF RODENT TUBER (*THYPHONIUM FLAGELLIFORME*) AND KECBELING (*STROBILANTHES CRISPUS*) EXTRACTS DURING HEPATOCARCINOGENESIS

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There is interest worldwide in the use of plants and herbs for the treatment of various ailments including degenerative diseases. This study was carried out to determine the anticarcinogenic effects of roder tuber (Thyphonium flagelliforme) and kecibeling (Strobilanthes crispus) aqueous extracts on hepatocarcinogenesis in rats induced by diethylnitrosamine (DEN) and 2-acetylaminofluorene (AAF).

The effects of these extracts on rat hepatocarcinogenesis were assessed by tumor biomarkers, histological and electron microscopy examinations. Glycyrrhizin, a drug used in the treatment of liver cancer was used as a comparison (0.005% , w/v). Administration of 200 mg/kg diethylnitrosamine (DEN) as the initiatior and 0.02% of 2-acetylaminofluorene (AAF) as the promoter significantly increased the activities of both plasma and liver microsomal γ-glutamyl transpeptidase (GGT) ($p<0.05$), liver microsomal uridyl diphosphoglucoronyl transferase (UDPGT) ($p<0.05$), cytosolic glutathione S-transferase (GST) ($p<0.05$), homogenate gluthione (GSH) ($p<0.01$) and also both homogenate and plasmaalkaline phosphatase (ALP) ($p<0.001$). Supplementation of Thyphonium flagelliforme (0.05%, w/v) and Strobilanthes crispus extracts (5%, w/v) to normal rats did not show any effect on the tumor markers. However the DEN/AAF treated rats receiving both extracts significantly decreased the activities of plasma and liver microsomal UDPGT 9$p<0.05$), liver GST ($p<0.05$), liver ALP ($p<0.01$) and the concentration of GSH ($p<0.01$) than in the control. Glycyrrhizin, which was given to the DEN/AAF treated rats similarly, reduced all markers except for ALP. DEN/AAF caused hepatocytic dysplasia in liver of the rat in 8 weeks of treatment, which was evidently suppressed by both plant extracts. Severe damages caused by DEN/AAF to the cellular organelles could also be clearly seen with TEM, however, no changes were seen on the cells and its organelles when the cancer induced rats were supplemented with both extracts. These results indicate that crude extracts of Thyphonium flanelliforme and Strobilanthes crispus administered at this supplemented dose to the DEN/AAF treated rats could inhibit the promotional stage of hepatocarcinogenesis as glycyrrhizin.

OIL POLLUTION IN THE STRAITS OF MALACCA, MALAYSIA: APPLICATION OF MOLECULAR MARKERS FOR SOURCE IDENTIFICATION

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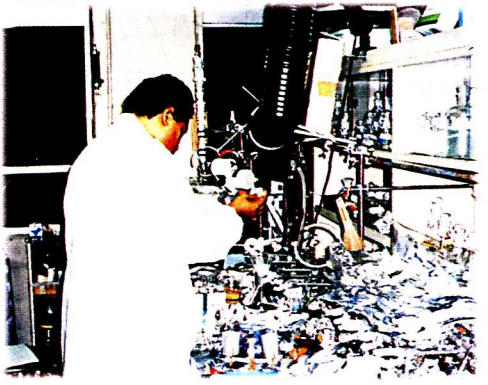

The Straits of Malacca is one of the world's busiest supertanker routes and tanker-derived oil spills occur frequently. In addition, domestic oil spills have been increasing due to growing industrialisation of Malaysia. The determination of the exact source of the spills is critically important.

This research examines the utility of biomarker compounds, triterpanes, to identify the source of the oil spills. Middle East crude oils (MECO), South East Asian crude oils (SEACO), tar-balls, sediments and mussels were analysed. The most distinctive compositional features for the crude oils are that 17α, 21β (H) C29 norhopane and C31-C35 homohopanes, especially C35 homohopanes, are depleted in SEACO. These remarkably different hopane compositions can be explained by the fact that MECO and SEACO are derived from carbonate (marine) and lacustrine/deltaic shale (non-marine) source rocks, respectively. Two of the 8 tar-balls samples collected on the coast of Peninsular Malaysia were derived from Middle East petroleum based on their biomarker signatures.

The results of oleanane analyses imply that low a concentration of oleanane does not always indicate a Middle East petroleum contribution although at high concentration oleanane can be a useful biomarker for South East Asian oil sources. Application of the source-identifier to sediment and mussel samples showed the Middle East oil signature. One possible explanation is that Middle East oil is used in formulating Malaysian lubricating oils which are the source of oil found in sediment and mussel samples. This is consistent with the analytical results for the lubricating oil used in Malaysia and the street dust samples.

One of the most important applications of this research in Malaysia is fingerprinting of the exact source of oil spills. The authorities will be able to apply the molecular marker approach to monitor oil pollution in Malaysia. The method is very accurate and inexpensive. Furthermore, the government will be able to nail-down the parties responsible for spilling the oil.

PRODUCTION OF HEALTHY LEAN MEAT

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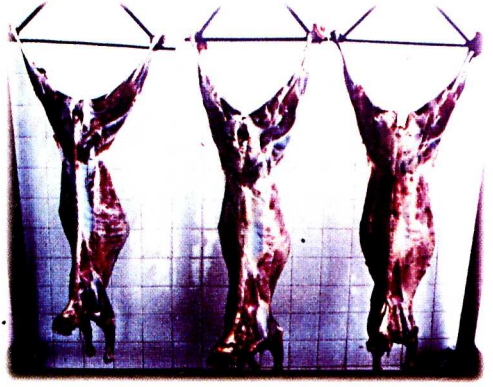

Thirty percent of the Malaysian consumers do not eat mutton because of its high-saturated fatty acid content, which may produce health risks. About 90% of polyunsaturated fatty acids (PUFA) which posses beneficial activities in both human and animal health are biohydrogenated to saturated fatty acids by the rumen microorganisms. Biohydrogenation can be reduced through feeding manipulations to facilitate PUFA enrichment of the animal tissues to produce more unsaturated mutton and improved carcass quality.

Oil palm frond can be utilised as a feedstuff under intensive rearing systems to produce unsaturated mutton. This represents an enormous economic potential in the feed and animal industry. The PUFA enriched mutton and improved carcass quality would benefit the consumer and food industry. Dietary manipulations on a commercial scale can be employed to increase the local healthy meat production.

Experiments in sheep fed diets oil palm frond (OPF) pellets and commercial sheep pellets (CP) for 14 weeks showed a significant 40 % increase in plasma PUFAω6 in the animals fed with 80 % CP: 20 % OPF. The unsaturated: saturated fatty acid ratio for this group increased from 1.52:1 (beginning of trial) to 1.64:1 at the end of the trial. The PUFA profiles for the mutton showed similar trends where the unsaturated: saturated fatty acid ratios were significantly raised to 1.62:1. The ω3: ω6 ratio of 1:6.9 obtained was close to the 1:6.0 ratio recommended for the American diet. Carcass quality was improved with significant the loin eye area and muscle weight. The average daily gain for this group was 118 g/day.

Circulating levels of high density lipoprotein (HDL), low density lipoprotein (LDL), total cholesterol, Ca^{++} and Mg^{++} are presently being monitored in rats. Evidence of trace arteriosclerosis in selected blood vessels is being investigated using confocal and electron microscopy.

ILLTHRIFT IN SHEEP AND GOATS: THE ISOLATION OF THE PARENT TOXIC COMPOUND FROM *BRACHIARIA DECUMBENS*

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Ill-thrift is a form of sub-clinical disease due to a number of nutritional disorders. In Malaysia, apart from trace mineral deficiencies, the toxicity of *Brachiaria decumbens* (signalgrass) can also predipose animals to ill-thrift.

Currently, *Brachiaria decumbens* (signalgrass) the grass accounts for about 85% of the grass found in the grazing paddock in Malaysia. However, the popularity of *B. decumbens* is declining as cases of toxicity in ruminants began to rise. Attempts towards eradicating this grass was futile and costly. Research on the toxicity of this grass initiated since the early 80's has yielded inconclusive results.

The first major research breakthrough was the demonstration by Noordin and coworkers in 1993 of the presence of toxins from the rumen of intoxicated sheep and the isolation of the toxin from the grass itself in August 1999. This compound, a saponin, is believed to be the parent toxic compound responsible for changes seen in intoxicated animals. This discovery has significantly contributed not only to the understanding of the pathogenesis but also abolished the enigma clouding the toxicity for over six decades.

Undoubtedly, this discovery has made it is possible to destroy the toxin economically thus ending the costly approach of eradicating this grass from pasture. Eventually, this might serve as the driving force to boost the sluggish ruminant industry.

PRODUCTION OF STAINLESS STEEL COMPONENT BY METAL INJECTION MOLDING TECHNIQUE

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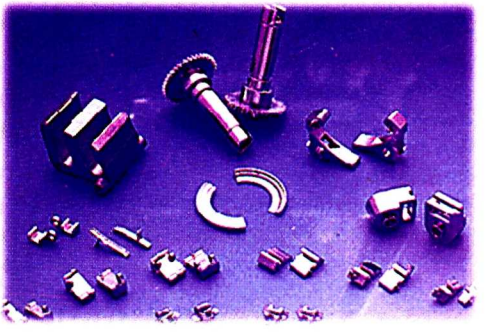

Metal injection molding (MIM) technique is an advanced manufacturing technology and represents an optimum method for developing high performance near net shape and superior property samples. MIM is a sequence of manufacturing processes consisting of mixing, injection molding, debinding and sintering. Since the finished products can be formed into complex shapes with compact density and miniature sizes, the technique is therefore superior to other conventional methods i.e. casting, forging, powder pressing.

In the project, thermoplastic binder is mixed with stainless steel powder. The mixing is carried out using a z-blade mixer at temperature of between 130°C and 160°C for 1 hour. The mixed material called feedstock is injected in the MIM machine at different pressures and temperatures. The injected product also known as green body is then produced and its density is investigated as a function of the injected pressure and temperature. The green body is then debinded at a rate of 0.2°C per minute from room temperature until 440°C under normal atmosphere. The debinded specimen is then sintered at different temperature under hydrogen atmosphere. The finished product is then tested for physical and mechanical properties such as density, porosity and hardness. Investigation of other properties of the finished product such as ultimate tensile strength, Young modulus, elongation and microstructure were also carried out.

Metal components produced by MIM are used widely in industries. These include small and complex shape components such as parts for electrical motor, power windows, cameras, computer hardware, souvenirs and gifts, cutting tools, medical instrument, sporting equipment, high quality household items, and wear-resistant tools. This will help the relevant industries such as automotive, electronics, computer, biomedical, and tourism, to optimise their production cost as the supply of components can be manufactured locally.

The quality of MIM finished products is excellent and therefore has a high commercial value. They can also be readily mass-produced. In addition, there are available finished products that can only be produced by MIM technique.

TOWARDS THE PRODUCTION OF MALAYSIAN MADE SOLAR ADSORPTION REFRIGERATOR

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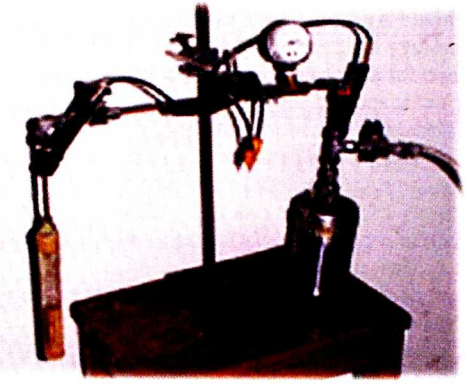

Adsorption solar refrigeration is an attractive application in the field of solar energy because of its simple concept and ease of operation while at the same time requires little maintenance. In addition, the capital cost of an adsorption solar refrigerator is lower than other cold production systems. Also, its operating cost is almost zero. The system only requires heating which can be effected by solar radiation in the day and cooling by ambient atmosphere at night.

The adsorption solar refrigerator uses activated carbon and methanol as the adsorbent and refrigerant pair. Under heating and cooling, activated carbon exhibits adsorption and desorption properties of a close cycle type consistent with the refrigerant used. By exploiting these thermodynamic properties, the methanol can be used to absorb the heat from a pool of water contained in an evaporator during the adsorption cycle. The heating on the collector containing the activated carbon is carried out during the day using solar radiation. The cooling process is imposed in the night by manually releasing dampers on the underside of the collector.

Research on three types of activated carbon obtained locally was carried out to determine the most suitable activated carbon for used with the prototype. An experimental rig shown in the picture was set up for this purpose. The amount of methanol absorbed by the different activated carbon was measured for varying activated carbon temperature while keeping the methanol temperature fixed. The measurement was then repeated for different methanol temperature. From the results of the experiment, the Coefficient of Performance (COP) of the adsorbent-refrigerant pairs was deduced. A maximum COP of 0.6 was the best that could be achieved from these activated carbon samples. This figure compares well with some of the finest activated carbon produced overseas.

The solar adsorption refrigeration system finds economical use in small and medium scale food and cold storage industries. It can also be used in remote hospitals (for storing vaccine), resorts and hotels, fishing trawlers, boats and vessels, caravans, camping sites.

RESPONSE OF THE SOUTH CHINA SEA TO ATMOSPHERIC FORCING

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The monsoon seasons have very strong impact on the variability of the physical oceanographic parameters, in the South China Sea (SCS). Our research group has studied the physical variability of the SCS in response to the monsoon seasons and other atmospheric conditions, which has involved several oceanographic cruises (both local and international). During the Northeast monsoon, the ocean mixed layer is deeper as compared to during the Southwest monsoon. This is due to increase vertical mixing by the high waves generated by stronger winds during the Northeast monsoon.

An increase in sea level, due to piling up of water during the Northeast monsoon, will cause flooding in lowland areas along the eastern coast of Peninsular Malaysia. Using over ten years of time-series tidal data, we studied the mean sea level variations in the SCS. Minimum and maximum mean sea level is observed in June and December, respectively. The amplitude (the difference between maximum and minimum values) decreases from 50 cm in the north to 28 cm in the south along the eastern coast of Peninsular Malaysia.

The surface current circulation in the SCS is influenced by the direction of the monsoon winds, which will affect the climate of countries around the SCS. Surface current, along the eastern coast of Peninsular Malaysia, tends to flow southward and northward whenever the Northeast and Southwest monsoon winds prevail, respectively. However, during the transitional period, where the winds are variable and light, local winds (such as the land and sea breezes) are predominant. Eddies have been observed in this period.

We have studied the seawater intrusion into Terengganu and Ibai estuaries, in the eastern coast of Peninsular Malaysia. Seawater intrusion increases and decreases during the Southwest and the Northeast monsoon seasons, respectively, in there two estuaries. These intrusions of seawater have significant effect on aquaculture and agriculture activities in the semi-enclosed water bodies.

CURRENT PRACTICE IN BAUNG LARVICULTURE

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Baung, *Mystus nemurus*, is one of the popular indigenous freshwater food fishes. Due to the success of its induced breeding program, this fish has been promoted as a new aquaculture species and its production (ponds, cages and pens) has become significant since 1993.

The quality of fries produced is very much dependent on the quality of larval food. *Artemia* nauplii are widely used in hatcheries as sole food for baung larvae. *Artemia* cysts are imported mainly from the USA and are often expensive. In addition, the price, supply and quality (hatchability and nutritive values) of the cysts always fluctuate. Other than high risks of contamination and diseases, the production of *Artemia* nauplii requires extra facilities and labor which increase fry production cost.

The Development of Larval Feed *Putra MF* at Universiti Putra Malaysia started in 1993. In developing the prototype larval diet, the research group took a comprehensive and integrated approach studying the larval mouth morphology, gut morphology and physiology, digestive enzymes, feeding behavior, nutrient requirements, etc. With the right weaning scheme and the prototype diet, high and consistent survival rate and growth can be achieved in baung larviculture similar to those produced by *Artemia*.

Advantages of Larval Feed *Putra MF*

- ☆ High consistent growth and survival rate ⇒ High quality baung fries
- ☆ High quality diet
- ☆ Extremely low risk of contamination and diseases
- ☆ Convenient
- ☆ Reduces Artemia and other live food dependency up to 80% or more.

ANTI-AMOEBIC ACTIVITIES OF COMPOUNDS EXTRACTED FROM *MURAYA KONIGII*'S BARK: *IN VITRO* STUDY

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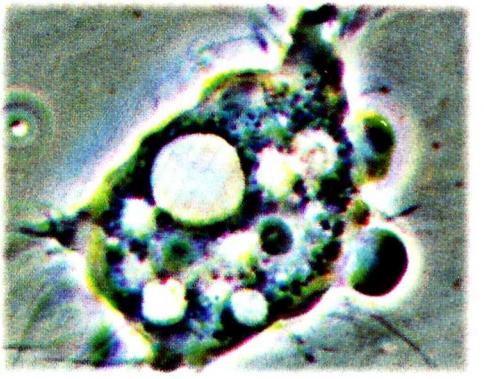
Picture not available at time of print



Most free-living amoebae (FLA), such as *Acanthamoeba* spp are facultative pathogens. In 1997, six clinical isolates from corneal ulcer of four patients, were found to contain *Acanthamoeba sp.*(Nakisah dan Suryana, unpublished work). Acanthamoeba keratitis is difficult to treat since this protozoan is resistant to drugs available in the market. According to Mohd Kamel, UKM, KL, personal communication) has found Brolene eye drops (May and Baker; propamidine isethionate) to be effective in the treatment of human keratitis but this drug is not readily available in Malaysia

In this study, the compounds extracted from *Muraya koenigi* 's bark viz its crude extract and its pure compounds, mahanimbine and girinimbine were tested on pathogenic amoeba *Acan-thamoeba castellanii in vitro* (obtained from Institut of Medical Research, Kuala Lumpur). The results of the study indicated that IC_{50} (concentration to inhibit 50% of the amoeba growth) for mahanimbine, girinimbine, mixture of the two compounds and crude extract are 1.18 ppm, 3.04 ppm, 31.22 ppm and 85.33, respectively. Mahanimbine showed the highest anti-acanthamoeba activity, followed by girinimbine, mixture of mahanimbine and girinimbine and the crude extract. Even though mahanimbine and girinimbine show very high anti-acanthamoeba activities, anti-amoebic activity of the mixture was reduced compare to when they react on the amoebae independently. The molecular structure of the two pure compounds is noticed to have an idol unit, perhaps to indicate whether the molecule has anti-amoebic activity or not. Anti-*Entamoeba histolytica* agents such as usambarensin and usambarine have been reported to possess this indol unit.

Results of this study suggest that pure compounds extracted from *Muraya konigii's* bark have a potential as alternative drugs for Acanthamoeba keratitis. Further study however, should be carried out to test their anti-amoebic activity *in vivo* either on human or animals before they can be consumed and placed in the market.

PRODUCTION OF INSECT VIRUSES FOR THE CONTROL OF INSECT PEST, *SPODOPTERA LITURA*

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Spodoptera litura or commonly known as armyworm, is a common pest in vegetable crops such as cucumber, ladies finger, crucifers, brinjal, chilli and also in crops such as watermelon and maize. The larval stage is the most serious as it feeds on leaves and young shoots leaving behind the twigs. These damages certainly would affect the yield of the crops. Currently, the only effective and recommended means of control is through the use of chemical insecticide sprays.

The excessive dependence and over usage of chemical insecticides have led to increasing concern over the safety of food materials produced. An alternative to chemical insecticides has to be sought in order to safeguard the consumers as well as to protect the environment.

A research project is currently being carried out at Universiti Putra Malaysia in collaboration with MARDI to find ways to overcome this pest problem. We have isolated two types of viruses from infected *S. litura* larvae. The viruses are from the Baculoviridae, *Nucleopolyhedrosis* (NPV) and *Granulovirus* (GV). They are large viruses, occluded and contain DNA. GV comprises capsules containing a single virus particle while NPV has polyhedra containing many occluded virus particles with several nucleocapsids per envelope. Both viruses are specific to the larvae of *S. litura* that means they do not infect other insects. The larval stages, which cause serious damages to crops, are the most susceptible to virus infections and causing death in a matter of days. The median lethal concentration (LC50) values for GV and NPV are 8×10^5 and 1.8×10^5 PIBs/ml, respectively, when bioassayed against newly hatched larvae. Thus, indicating a high rate of pathogenecity to the most destructive stage of *S. litura.*

Ii is hoped that both viruses can be produced and formulated commercially as an alternative to chemical pesticides so as to protect the consumers as well as the environment.

NOVEL APPROACHES TO THE CONTROL OF GASTROINTESTINAL PARASITES IN SMALL RUMINANTS

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In Malaysia worms pose a major problem to the sheep industry, contributing to one-third of mortalities. The objectives of this project are to select sheep resistant to worm (trichostrongyle) infection and to breed the selected animals.

The breed of sheep used was pure Santa Ines belonging to the Department of Veterinary Services Malaysia. The parental sheep generation grazed on pastures naturally contaminated with the worm larvae. The animals were classified into resistant and susceptible groups, based on their response to the natural infection. There is an established strong positive correlation between strongyle worm infection and their faecal worm egg counts. This is true only for young animals below six months old before acquired immunity is obtained. Hence resistant rams and ewes were identified as animals which had low faecal egg counts and susceptible ones were those which had high faecal egg counts. This classification was again tested in pen challenge experiments. When these animals achieved maturity they were mated; resistant rams with resistant ewes and likewise for the susceptible animals as a control. The offspring at 3-4 months old were challenged with worm larvae to confirm their responder status as well as to study the inheritance of resistance. Blood samples from the pedigrees were investigated for inheritance of genetic polymorphism.

The findings revealed significant differences in faecal egg counts between resistant and susceptible lambs both in natural and experimental infections. This reflects a difference in worm burden between resistant and susceptible animals. Also there were differences in haematological parameters in the two sheep lines. The results also show that inheritance of RAPD markers are detectable within families and are highly reproducible.

In summary, the phenotypic tools used to identify animals resistant to worms have been ascertained. Resistant animals have been identified and they can be used in breeding programs to upgrade the resistant status of the general sheep population against worms.

CHARACTERISATION AND MANAGEMENT OF ACID SULFATE SOILS IN MALAYSIA

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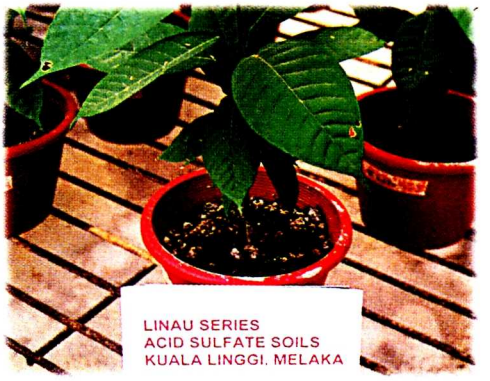
Acid sulphate soils are mostly found in the coastal plains of Peninsular Malaysia in an area of about 0.5 m ha. In Malaysia, This soil is planted with oil palm, coconut, cocoa and rice with low yield and without proper management practices. Problems occur when the soils become too acid after development. Under this condition, A13+ ions exist at the level toxic to the crops, lowering the yield.



Studies at The Centre for Tropical Soil Studies have demonstrated that the occurrence of acidity is due to pyrite (FeS2) oxidation after it is exposed to the atmosphere when the soils are developed. This pyrite accumulates when the areas are inundated with seawater over a long period of time. As a result of pyrite oxidation, a new mineral named jarosite ($KFe_3(SO_4)_2(OH)_6$) is formed. A mechanism for jarosite formation has been proposed by us and accepted by the scientific community. Heavy metal such as Cd, As, Pb, Zn and Ni can exist in the pyrite structure. In that situation, these toxic metals can be released, polluting soils and water in the surrounding areas. However, it is proven that Cd and As are absent in our soils. Thus, we do not have to worry about Cd and As poisoning when our acid sulfate soils are developed.

The main reason for crop failure is A13+ toxicity. Removal of A13+ via conventional method is ineffective. It is found that the root of oil palm seedling is correlated with A13+ activity. Fortunately, oil palm is tolerant to acidity. It can survive provided that A13+ does not exceed 100 µM and pH is > 4.3. The study will concentrate on quantification of acidity in the soils. The available data will be used to relate to cocoa production and environmental pollution. Preliminary result indicates that cocoa is sensitive to A13+. A method to alleviate the A13+ toxicity is being worked out.

Researchers at the Centre for Tropical Soil Studies have shown their capability to identity the source of degradation of acid sulphate soils, beside being able to propose an effective method of alleviation. Information gathered is important and useful for the management of acid sulphate soils for sustainable crop production, especially oil palm and cocoa.

A METHOD TO ESTIMATE RELATIVE ECONOMIC WEIGHT TO MORPHOLOGICAL TRAITS IN OIL PALM BREEDING

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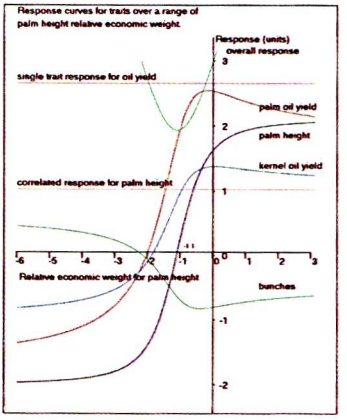

Oil Palm (Elaeis guineensis, Jacq) is a perennial crop extensively used in the commercial production of edible oil. Having the genes for high yield alone is not sufficient. Output, agronomic aspects of growing the palm and product quality all govern commercial viability. Fruit bunches must be easy to harvest. Therefore, the breeders' task is to manipulate the genes to achieve improvement in several characteristics. This is achieved using a multitrait selection approach. Commonly used multitrait genetic evaluation tool is selection index, an extension of which is the popular Best Linear Unbiased Prediction, BLUP, method. In constructing the index, differential selection pressure, or relative economic weights, are applied to each trait. Multi trait selection that include traits other than yield traits alone is not popular in plant breeding because of the difficulty in estimating weights for traits like palm height, leaf area and disease resistance.

This research develops an algorithm to objectively calculate an economic weight to decrease palm height while rationalising any compromise expected in gains in the yield traits. A set of restricted indexes was based on the level of compromise acceptable in yield traits rather than solely on a desired level of expected responses. Another index is the optimised index where a weight is assigned to palm height at the point when marginal loss in yield traits is offset by the marginal gains in palm height. At this point, gain from combined yield traits is highest when expressed as a proportion of overall response. This optimised index was 28% more efficient than the standard for the parameters used, and the optimum weight for palm height was –0.67. The method developed here allows an appropriate choice of economic weight to be made while considering trade-offs in the other traits. This was consistent at various levels of heritability of palm height. Depending on the magnitude of the responses, the breeder could then adjust the economic weight of palm height according to costs associated with this trait unique to his farm.

PRE AND POST HARVEST TECHNOLOGY OF MALAYSIAN FRESH FRUITS AND VEGETABLES

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This research enables the storage life of fresh fruits and vegetables to be extended longer than usual by using new pre and post harvest techniques. The best coating formulations could maintain the freshness and texture of fruits, reduce weight loss, delay ripening and spoilage during storage. The vitamin C contents of fruits coated with the best formulations were higher than untreated fruits. Treated fruits were often preferred for their taste, colour, texture and overall acceptability. The treatments could reduce chilling injury and other postharvest diseases.

Commodities that have been studied include various types of pineapples, bananas, guava, sapodilla, starfruit, papaya, durian, citrus fruits, rambutans, mangosteen, honey dew, ginger, breadfruit and various Malaysian flowers. Among others the storage life of pineapples could be extended from 1 week to 9 weeks after treatment, guava could be kept for 8 weeks and durian for 3 months. An export shipment trial of fresh pineapples to Europe showed that the fruits were in excellent condition even after 9 weeks storage.

Preharvest treatments investigated include the determination on the optimisation use of fruitone CPA [2-(3 klorofenoksi) asid propionik]. Fruitone treatment increased pineapple weight, reduced crown size and weight loss of pineapples during storage, delay ripening and increased fruit density. Fruitone reduced black heart disorder and marbling disease in pineapples. Sensory evaluation showed that fruitone improved the taste, colour, texture and appearance of pineapples. This makes possible the use of varieties that were previously unsuitable for export in the fresh form due to chilling injury and mechanical damage.

These postharvest technology research have great potential for commercialisation and several companies are willing to collaborate with the researchers in exporting fruits overseas using the new formulations discovered. The agriculture industry could use the technology to expand their export market and improve the socio-economic status of the country.

MALAYSIAN NUTRACEUTICAL (HEALTH FOOD) RESEARCH

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The nutraceuticals produced from plant and microbial sources, can reduce blood cholesterol, hence prevent degenerative diseases caused by obesity and cardiovascular disorders. These can reduce blood glucose of diabetes patients, increase ones vitality and resistance to diseases, delay ageing and prevent cancer. Raw materials are mainly from local plant and microbial sources. Among them are also materials that are antimicrobial and antifungal.

This research has deepened our knowledge on the beneficial effects of local plants that are most effective against free radicals, which have been linked to premature ageing, cancer and cardiovascular diseases. Various indigenous plants have been screened for antimicrobial, and antifungal activities against pathogenic and food spoilage microorganisms. The research has also screened for the antioxidative activities of local edible plants, their vitamin E, polyphenols and flavonoids content and have been reported in more than two hundred publications in books, scientific journals, and other articles (magazines, and newspapers).

Cardiovascular disorders (heart ailments, stroke, hypertension, diabetes) and cancer are the main causes of death in Malaysia, hence this research can improve the socio-ecomony status of the country by reducing medical expenses and improve the health of the Malaysian population. Market surveys conducted indicate that on average Malaysians spend between RM50-RM 100 a month on health products or nutritional supplements most of which are imported. Local products can reduce foreign exchange and increase the production potential of this country.

This study is actively working towards technological advancements in finding ways to produce drinks pills, powders, snacks, food or bakery products that taste good. Several local companies have indicated interests in commercialising products from this research.

COMMERCIAL PRODUCTION OF SHIITAKE AND OTHER NOVEL MUSHROOMS

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The cultivation of mushrooms worldwide represents the only profitable, large scale controlled application of microbial technology for bioconversion of lignocellulosic waste residues. Global production value of mushrooms exceeds U.S.$ 1 billion annually.

We have developed an environmentally-controlled precision technology for a cost-effective commercial production of the shiitake mushroom, *Lentinula edodes,* which can be adopted for a few other novel edible mushrooms.

The shiitake mushroom is commercially the most important mushroom in Malaysia and the Far East. Fresh shiitake fetches a high retail price between RM 25.00 - 35.00 per kilo on the Malaysian market with imports of this delicacy reaching RM 30 million annually. There is a ready local market for these gourmet mushrooms with an existing export market as well (Japan, Singapore). Return on investment is great, while the rate of return is fast. There is little competition as only one major commercial grower exists in Malaysia.

The shiitake ('donku') or black forest mushroom has traditionally been cultivated on hardwood logs, mainly oak. However due to the dwindling supply of hardwoods, the long gestation period and low yields, an alternative technology has been developed. The 'new' technology involves cultivation on synthetic logs of supplemented sawdust and woodchips. Yields as high as 145 % (compared with 10 % from natural logs) can be obtained. The incubation period is also much shorter (six months) compared to production on bedlogs (three years).

Specialized production techniques are employed to ensure that maximum flushes (harvests) are obtained with minimum contamination. We have devised similar technologies to produce other novel edible mushrooms of great commercial potential in Malaysia such as the tropical button, bunashimeji and maitake mushrooms.

PRODUCTION OF NUTRICEUTICALS FROM LINGZHI MUSHROOMS

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The lingzhi or reishi mushrooms, *Ganoderma* spp. are acknowledged as mushrooms which possess great medicinal significance with reported attributes such as possession of immunopotentiating, antitumor and hypocholesterolemic properties, as well as functioning as renal and hepatic protectants. Lingzhi has a 2000-year history in the annals of Oriental medicine and has traditionally been used as a health food supplement (nutriceutical) in many cultures, in countries like Japan, Korea and China, and recently in western countries. In Malaysia, the sale of medicinal products derived from lingzhi is estimated to exceed RM 200 million annually, with most of these products being imported. Sales are conducted either over-the-counter (OTC) or by multi-level marketing.

Generally there are four different classes of active compounds, the polysaccharide, triterpenes, organic germanium and adenosine, which contribute to the medicinal effects of lingzhi. The most important component among them is the polysaccharide β -1,3-glucan. This glucan has received much attention in the field of cancer immunotheraphy because of its remarkable tumor inhibitory activity.

We have successfully cultivated several strains of lingzhi from *G. lucidum, G. tsugae, G. tropicum and G. applanatum* under stringent microbiological conditions and with an appropriate technology to yield a product where the potency of the active ingredients is preserved. The product is in the form of a powdered extract or biomass from the vegetative mycelium or mushroom fruit body, presented in capsules or incorporated into beverages. It is non-toxic and free from heavy metals and microbial contaminations. We have developed methods using fluorometry, chromatography and enzymes to quantify the active ingredients present, ensuring product quality. We have discovered the best strains, growth media, stage of harvest, cultural and environmental conditions, and processing technique to yield a product of the highest quality for the market.

FLOWER FORCING OF TULIP UNDER TROPICAL CONDITIONS

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Tulips are considered as one of the most attractive spring bulb flower in Europe and other western countries. The Netherlands is the world largest producer for bulbs and export worldwide to meet the demand for cut flower, garden planting and pot plant production. Malaysia, on the other hand is well known for tropical flowers especially the wide range of orchid hybrids. Besides, we are able to produce some temperate flowers like roses, chrysanthemums, carnations and others for local consumption and export market. So, the floriculture industry in this country is one of the important elements in our agriculture sector.

Due to the increase demand of some exotic flower species especially during festive season, an effort have been in the past two years to produce tulip flower under our tropical conditions. This is a big challenge because previously tulip can only be produced in the temperate countries.

Through the selection of suitable cultivars and a scientific approach coupled with good understanding of physiological processes involved during flower formation, tulip pot plat and cut flower production has become reality. In order to obtain high quality tulip and accurate control the timing of flowering, proper schedules of temperature treatment for bulb storage and flower forcing are important. Our research findings show that 22/18 °C day/night forcing temperature is the ideal forcing temperature.

Besides tulip production, two plant growth retardant, reduce the final plant height of potted tulips can be overcome by Paclobutrazol and flurprimidol at 20 mg/liter and 80 mg/liter respectively. On the other hand, the excessive elongation of the flower stalk of tulip as a cut flower will cause the bending of the flower stalk before the senescence of the flower. In attempt to prolong the shelve life and reduce the excessive elongation of the flower stalk, we have used ethephon successfully

Our findings and techniques are expected make a significant contribution to the local floriculture industry and compete in the global market.

SURFACE PLASMON RESONANCE (SPR) OPTICAL SENSOR

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The concept of surface plasmons originates from the application of Maxwell equation to plasma, whereby the free electrons of a metal are treated as an electron fluid of high density (plasma). The density fluctuations occurring on the surface of such a fluid are called surface plasmons. Optical excitation of plasmons is not possible by direct impact of light on a metallic surface, so a prism coupling arrangement is needed. One possible mechanism is to use a p-polarised, collimated light beam passing through a glass prism that undergoes total internal reflection (TIR) at the prism-thin metal film-dielectric interface. In order to excite a surface plasmon, the component of incident wave vector parallel to the interface must be equal to the surface plasmon wave vector, This phase matching occurs when the incident angle in the first medium is greater than the critical angle.

In the present work, gold thin film with the thickness of 50nm was used as an active layer in contact with the medium to be studied. By using this technique the refractive index of the medium can be determined up to five decimals places. The sensitivity and the capability of this technique have been tested for various types of samples, such as liquids, solids, powders, creams and tissue. For measuring refractive index we have carried out measurements on Palm Oils (RBD Palm Oil, RBD Palm Olein and RBD Palm Stearin), heave latex, milk (solution and powder), blood, albumen and hair cream.

Since this technique is very sensitive to the changes of refractive index of the medium, the technique can be used as biological and chemical optical sensors. We have tested the capability of this sensor by measuring the water content in heave latex, honey, milk, acetone and methanol. This type of sensor can be constructed in small size and has a high potential to be used as a diagnosis tool and a sensitive optical sensor in medical and food industries. As in other optical techniques, it is non-invasive, non-destructive, non-hazardous and simple to operate.

RAPID DIFFERENTIAL SCANNING CALORIMETRY FOR MONITORING AND QUANTITATIVE DETERMINING QUALITY PARAMETERS IN EDIBLE OILS AND FATS

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The potential use of differential scanning calorimetric (DSC) technique in the field of oils and fats is enormous. Various thermal phenomena of oils and fats are fundamental subjects to elucidate their physical and chemical properties. An understanding of the thermal behavior of edible oils and fats is important for many practical applications involving thermal processing operations such as fractionation.

Detailed investigations were directed towards obtaining basic information about the relationship between thermal profile and chemical composition of 17 different vegetable oils. We find that DSC is an efficient and accurate method for characterizing edible oils. We also described and outlined the importance of thermal behavior of various palm oil products and concluded that the DSC thermal profiles can be used as guidelines for fractionation of crude palm oil or refined, bleached and deodorized (RBD) palm oil.

Lipid oxidation is a major deteriorative reaction affecting edible oils and is a primary concern to manufacturers and consumers. We developed a simple and reliable DSC method to monitor the oxidation of frying oils and to measure the antioxidant activity in RBD palm olein. We also developed and tested the DSC technique for quantitative determining various quality parameters in edible oils and fats. Seven new methods were developed to determine total polar compounds (TPC), free fatty acid (FFA) content and iodine value (IV), melting point (MP), cloud point (CP), iodine value (IV), and the composition of TAG groups of edible oil.

DSC appears to be a useful technique in determining various quality parameters of edible oils and fats, especially in our palm oil industry, and has the potential to replace the laborious, time- and chemical-consuming standard methods. Our new techniques could used in food industry monitoring oil quality that can either risk the public health or cause financial losses to the food industry.

NATURAL ANTIOXIDANT MIXTURES FOR CONTROLLING LIPID OXIDATION DURING DEEP-FAT FRYING—STABILITY, OPTIMIZATION AND COMPARISON TO ARTIFICIAL MATERIALS

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The lipid composition of food systems cooked by deep-fat frying will potentially promote chemical changes within the frying oil.. Antioxidants are added to fats, oils and foods containing fats to inhibit the development of off-flavour arising from the oxidation of unsaturated fatty acids. However, with awareness concerning the safety of the synthetic antioxidants such as tetrabutyl hydroyquinone (TBHQ), butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) in food system, considerable increase in the use of natural sources of antioxidant for frying purposes.

Rosemary and sage, two herbs-derived antioxidants have been intensively studied in this research work and proven to be effective for stabilizing palm oil during deep-fat frying, while having very good thermal resistance. The finding of this study also revealed that both antioxidants retarded oil deterioration during frying and increased the acceptability of fried product. For some quality parameters examined such as peroxide value, anisidine value, free fatty acid and polymer content, colors, viscosity, iodine value and alkaline contaminant materials, results showed that oil samples treated with the antioxidants were significantly better than control. Together with citric acid as a synergist, these natural antioxidants applied in deep-fat frying of potato chips significantly influenced appearance, taste, crispiness, odor and overall acceptability of the fried product. It was also clear that the three antioxidants had synergistic effects on the retention of fatty acid profiles of the RBD palm olein. Using response surface methodology (RSM) technique, it was found that a combination of 0.076% rosemary extract, 0.066% sage extract and 0.037% citric acid produced the optimum retention of fatty acid composition in the oil.

Natural antioxidants derived from rosemary, sage and synergist with citric acid could retard the deterioration of RBD palm olein during deep-fat frying. These natural antioxidants was comparable to, if not better than TBHQ, BHA and BHT, thus they could replace those synthetic antioxidants which have been questioned due to possible undesirable side effects.

RAPID FOURIER TRANSFORM INFRARED SPECTROSCOPIC ANALYSIS FOR DETERMINING SOME TRADING PARAMETERS OF PALM OIL

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Fourier transform infrared (FTIR) spectroscopy has been widely accepted as a reliable analytical technique for more than 20 years. It was initially used in the analysis of agricultural commodities and food for oil, protein, carbohydrate, moisture and other components. FTIR spectroscopy has come of age in terms of price, performance, and ease of use. Coupled with an attenuated-total-reflectance (ATR) accessory or a transmission flow cell, through the use of instruments macro programming, an FTIR spectrometer can be considered a potentially cost-effective tool for quality-control applications in the food industry. Since its introduction, it has largely replaced manual analysis by chemical methods, improving efficiency, and reducing the requirement for skilled labour and the use of hazardous chemicals without sacrificing accuracy.

In our research, FTIR spectrometry has been tried for iodine value (IV), free fatty acids (FFA), peroxide value (PV), anisidine value (AnV), moisture content, thiobarbituric acid reactive substance (TBARS), detection of lard in mixture of animal fats, and detection of aflatoxins in palm kernel cake. Simple Beer's law, partial least square (PLS) analysis, and principle component regression (PCR) were used to develop calibration models followed by validation procedures testing the predictive capability of the calibration models. Interest in this technique for analysing palm oil products arose from a need to replace classical chemical analysis with instrumentation to benefit from the many advantages of the technique mentioned above.

FTIR techniques can be used as alternatives to a variety of chemically based palm oil analysis methods that are tedious, time-consuming and often involve environmentally unfriendly reagents. The FTIR techniques potentially can provide the palm oil industry with means to significantly reduce the use of solvents and reagents in routine quality control as FTIR analysis can be performed directly on palm oil products, without the need for any sample preparation. Statistical analysis of the obtained results indicated good accuracy of the FTIR spectroscopic methods and showed that they are superior in producing constant results.

DEVELOPMENT AND TESTING OF AGRICULTURAL ENTREPRENEURSHIP TRAINING MODULES FOR SECONDARY SCHOOL STUDENTS

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It is important that more entrepreneurs operate the Malaysian agricultural sector. In order to raise more agricultural entrepreneurs, entrepreneurship education needs to be introduced at the secondary vocational agricultural schools. In this research, six modules pertaining to agricultural entrepreneurship training were developed for use at the schools. In conducting this research, the researcher attempted to (1) determine the suitability of the modules, and (2) test the effectiveness of the modules with respect to the students' perceptions and attitudes towards agricultural entrepreneurship, and their career aspirations.

Our conclusions are that more entrepreneurship training using the modular approach should be conducted at the secondary schools, especially at the vocational agriculture schools as voluntary or co-curricular activities. As entrepreneurs, by their nature, are autonomous individuals, the use of modules is considered to be more appropriate so as to maintain independent behaviours as well as to encourage self-directed learning among the prospective agricultural entrepreneurs.

The findings and the experiences gathered from this study indicate that trainers should continually test their training programs to ensure their effectiveness. An agricultural entrepreneurship-training program should not be a "one-shot" exercise but should be multi levels of short duration, progressive and logically sequential - the beginning of which should be vigorously promoted and pursued at the schools.

A two-day training program on agricultural entrepreneurship for in-school and out-of-school youth is now available. Enquiries should be directed to The Managing Director, University Business Centre, UPM.

BENEFICIAL PLANT GROWTH PROMOTING RHIZOBACTERIA FOR OIL PALM, BANANA AND VEGETABLE SOYBEAN

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In Malaysia, the effective use of PGPR (Plant Growth Promoting Rhizobacteria) in a cost effective and sustainable agricultural system has been clearly demonstrated for *Bradyrhizobium*-legume symbiosis but not for associative nitrogen fixing bacteria. In mid-1997, our research team embarked on several research projects to demonstrate the benefits of PGPR as bioenhancer and biofertiliser for oil palm, banana and vegetable soybean.

Glasshouse (UPM, Serdang) and field experiments (FELDA Research Station, Bukit Mendi, Pahang) were undertaken using newly germinated DxP Yangambi and tissue-cultured clonal seedlings of oil palm for 13 months, with and without labeled-N fertilizer (^{15}N). Results showed that PGPR (Sp7 (*Azospirillum brasilense*), UPMB 10 (*Bacillus* spp.)) could fix N_2 (48%), increase photosynthetic rate (50%) and stimulate top and root growth of young oil palm seedlings.

Recent finding conclusively demonstrate the beneficial effects of local PGPR (UPMB 10 and UPMR 48) on N_2 fixation, growth of oil palm and banana seedlings, and nodulation and yield of vegetable soybean.

The socio-economic implication of these findings is the possible reduction in N fertiliser usage (approx. RM611 million/year) to the oil palm industry. Banana and the high priced vegetable soybean growers would also get similar benefits. The beneficial application of PGPR will increase income through improved plant growth, high yield and reduced cost of fertiliser N and save labour cost through minimal repeated application of PGPR as compared to fertiliser-N. These locally isolated PGPR have very high potential for commercialisation and could also be used in the Malaysian PGPR inoculum technology, which is being developed by the research group.

FEED RESTRICTION EARLY IN LIFE, HEAT SHOCK PROTEIN 70 RESPONSE AND ACQUISITION OF ENHANCED HEAT TOLERANCE IN BROILER CHICKENS

Zulkifli Idrus

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The broiler chicken production in Malaysia is an important agricultural industry. Although the potential for further growth is obvious there are several constraints to the future development of the poultry industry in Malaysia. One of the most obvious constraints on poultry production is the hot and humid tropical climate. Our primary research interest is to develop practical operational strategies to enhance heat tolerance in broilers.

Our findings demonstrated that 60% (of *ad libitum* intake) feed restriction at 4, 5 and 6 days of age (F60) enhanced heat tolerance later in life. At market age, where the birds are most susceptible to heat stress, F60 broilers had smaller increases in heterophil:lymphocyte ratios (a biological index of stress), and improved growth, antibody response to Newcastle disease vaccinations and survivability than those fed *ad libitum* (AL) in response to heat stress ($38\pm1^{\circ}C$ for 2 hours per day from 35 to 42 days of age). Of major interest is that while 22% of the AL birds succumbed to the heat treatment, all their F60 counterparts survived.

The present findings have provided significant insights into the mechanism of neonatal stimulation and acquisition of heat tolerance at a molecular level. Our data indicated that although there was no detectable difference in HSP 70 expression between AL and F60 birds prior to heat exposure, a dramatic increase in HSP 70 response was noted in the latter but not the former. Thus, these results strongly suggest that enhanced heat tolerance by early-age 60% feed restriction could be attributed to the ability of the F60 birds to elicit adequate HSP 70 response during heat challenge.

Subjecting chicks to feed restriction early in life is realistic under practical situations as farmers could easily practised without affecting the cost of production. Our finding on the role of HSP 70 in eliciting heat tolerance by neonatal feed restriction is a major advancement in the physiology of stress at a molecular level. It would be of great value for further work to alleviate the adverse effects of heat stress on the productivity and welfare of poultry.

Section III - Products

UPM's research during the past five years has yielded over 40 products ready for commercialisation. These products are available for licensing to companies in the private and public sectors.

The products cover the fields of agriculture, biotechnology, livestock, advanced materials, natural products, engineering and food processing technology. A brief synopsis of each product is presented in the accompanying pages. For further information, please refer "Directory of Products, Services and Expertise", M.R. Jainudeen and Nayandeep Singh (Eds.), Universiti Putra Malaysia 1997.

BIOFERTILISER

Azizah Bt. Hashim

Department of Soil Science

Biofertilisers (e.g. biological nitrogen fixers) can substantially save the application of nitrogen fertiliser to most economic crops. The arbuscular mycorrhiza (AM) fungi is a biofertiliser that is being produced commercially by UPM. The VAM fungi has been successfully propagated and tested on several crops of economic importance to Malaysia. The crops tested were: green leafy vegetables, fruit species, plantation crops, horticultural crops, and forest species.

A 2-year-old Mangosteen

NUCLEAR POLYHEDROSIS VIRUS - BIOPESTICIDE

Ahmad Said Sajap and Norani Abdul Samad

Departments of Forest Management, and Biochemistry

Nuclear polyhedrosis virus (NPV) is a highly specific and naturally occurring biological control agent. It is harmless to natural enemies of the pest, environmentally safe and is less likely than chemical insecticide to develop insect resistance.

Nuclear Polyhedrosis Virus as a Biopesticide

HYDROPONICS AND PROTECTED ENVIRONMENT AGRICULTURE

Mohd Razi Ismail

Department of Agronomy and Horticulture

Package technology offers the production of horticultural crops under protected environment agriculture. Potential applications are in the food industry for fresh consumption or processed vegetables. Among the benefits of Protected Environment Agriculture are labelled vegetable products, residual free and low in nitrate. They are useful in the catering Industry, hypermarkets chains, food processing, and township developers.

Protected Environment Agriculture

BIOPESTICIDE

Mohd Yusof Hussein

Department of Plant Protection

A ladybird beetle commonly found in Malaysia, is the natural enemy of the aphids, which cause heavy crop losses especially to vegetables grown under protected structures (glasshouses, nethouses and rainshelters). The pupal stage of the ladybird is the most ideal and practical as a commercial product. Ladybirds can be mass-reared under artificial diets and the pupae can be harvested, stored and distributed in specially designed plastic containers.

Ladybirds

REHABILITATION OF EX-TIN MINING LAND WITH TIMBER SPECIES

Nik Muhamad Majid
Department of Forest Management

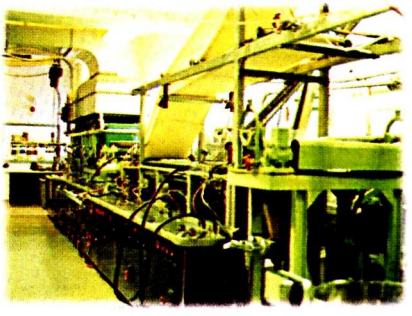
The agroforestry approach involving the interplanting of fast growing timber species and leguminous cover crops seem to be the best and most economical way to rehabilitate the exmining land and turn them into productive forest areas.

Timber Species in Ex-Tin Mining Land

A PULP AND PAPER MILL USING OIL PALM FIBRES

Jalaludin Harun
Department of Forest Production

Newsprint made from oil palm frond and empty fruit bunch fibres are available. The pulping system is more environmental-friendly compared with the traditional chemical pulping process and relies less in using recycle fibres. The mechanical pulp produced could also be used to manufacture other products such as Medium Density Fibreboard (MDF), which is currently produced from Rubberwood fibres as base raw materials.



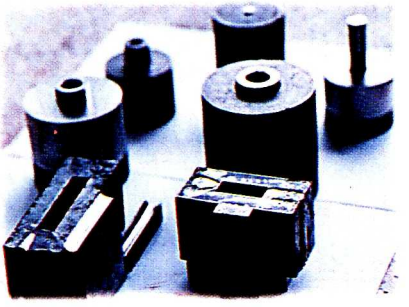
Pilot Paper Machine

MAGNETIC SOFT FERRITES

Mansor Hashim

Department of Physics

Various compositions of nickel-zinc and magnesium-zinc ferrites with small amounts of additives have been formulated for use in the electronics, computer and telecommunications industries. Magnetic soft ferrites are cheap, yet superior to other magnetic materials when used at MHz frequencies. Formulations with low-cost raw materials are available.



Magnetic Soft Ferrites

ACTIVATED CARBON

Mohd Zobir Hussein, Zulkarnain Zainal, Hj. Badri Muhammad and Ramli Ibrahim

Department of Chemistry

The activated carbon produced from oil palm trunks and shells is suitable for the production of granular activated carbon (GAC) with medium mechanical strength or powdered activated carbon (PAC). GAC and PAC find wide applications in food, chemical and pharmaceutical industries, as well as in gas/air treatment, water purification or special application such as batteries and catalysts support.

Activated Carbon from Oil Palm Trunks

MRT LATEXOMETER AND LIQUID MOISTURE METER

Kaida Khalid

Department of Physics

A Microwave Reflection Type Latexometer has been developed, patented (MY106441) and used by RRIM and RISDA. It is a rapid, easy to use, cheap, portable, non-destructive and accurate method for determination of dry rubber content (DRC) of *Hevea Latex*. The latexometer and liquid moisture meter are useful in latex collecting centres, latex-based, food and paint industries especially for process control.

Latexometer

TISSUE CULTURE OF ECONOMIC AND EXOTIC PLANTS

Marziah Mahmood, Radzali Muse and Abdul Manaf Ali

Departments of Biochemistry and Microbiology, and Biotechnology

A novel approach of producing planting materials and compounds of economic importance is available. The technology provides the feasibility of large-scale screening and selecting desirable cell, tissue and plants. Among the benefits of this technology are mass production of elite clones, and rapid multiplication of quality plants with uniform, disease-free and desirable characteristics.

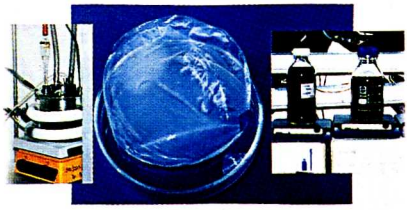
Plant Tissue Culture

BIODEGRADABLE PLASTICS

Mohd. Ali Hassan and Mohamed Ismail Abdul Karim

Department of Biotechnology

A new method has been developed for the production of biodegradable plastics from palm oil mill effluent (POME). This environment-friendly biodegradable plastic can replace petrochemical-based plastics in a wide spectrum of products. Unlike petro-chemical based-plastics, which are non-degradable, these bacterial-based plastics degrade in the soil or water to carbon dioxide and water within a few weeks.



Biodegradable Plastics from Oil Palm Effluent

DISEASE-FREE ORCHID PLANTLETS THROUGH *IN-VITRO* PROPAGATION

Norani Abdul Samad and Saleh Kadzimin

Departments of Biochemistry and Microbiology, and Agronomy and Horticulture

The *in-vitro* cell culture techniques have been developed for the mass propagation of commercial orchid varieties. The technique was combined with the modern diagnostic procedures to produce marketable and certified disease-free plantlets to produce high yield, grade one orchid cut flowers. This is particularly useful in cut-flower industries and commercial nurseries because the use of certified, disease-free planting materials will improve the health and yield of orchids.

***In-vitro* Propagated, Disease-free Orchid Plantlet**

MUSHROOMS AND THEIR NUTRICEUTICALS

Tan Yee-How and Mohd. Noor Wahab

Department of Plant Protection

There is currently much interest on herbal medicines. Medicinal products (nutriceuticals) have been produced from the lingzhi mushroom, *Ganoderma* sp. under stringent quality control to ensure efficacy and safety. Assay techniques for bioactive ingredients such as 1,3 β glucans have been developed, and heavy metal contamination is constantly monitored. Specialised technology is also available for commercial cultivation of the button, lingzhi, bunashimeji, white and black jelly, golden needle, nameko, oyster and monkey head mushrooms.

Mushrooms and their Nutriceuticals

ENZYME CATALYZED SYNTHESIS OF ESTERAMINES AND ESTERAMIDES

Abu Bakar Salleh, Mahiran Basri and Che Nyonya Abd Razak

Department of Biochemistry and Microbiology, and Chemistry

Esteramines and Esteramides can be synthesised using enzymes as catalysts. Fatty esteramines are the raw materials for producing biodegradable surfactants, fabric softeners, emulsifiers and washing up liquid. Fatty ethanolamides are used in detergents, cosmetic, shampoos, bubble baths, corrosion inhibitors, biocides and lubricant industries. The enzymymic synthesis of these speciality products are non-toxic and environmentally friendly, green processes.

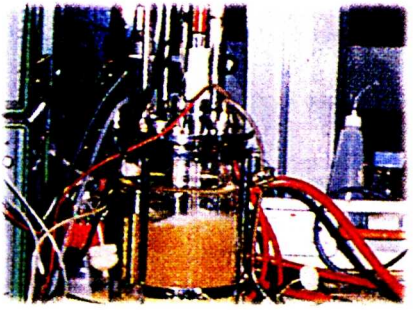
FPLC System: A fast method for preparation of biocatalysts

KOJIC ACID

Arbakariya Ariff, Rosfarizan Mohamad and Mohamed Ismail Abdul Karim

Department of Biotechnology

Kojic acid (5-hydroxy-2-hydroxymethyl-γ-pyrone) is widely used in the medical field as a painkiller and an anti-inflammatory drug. Kojic acid is used as a precursor of flavour enhancers, a skin care product for whitening, and a protective against UV light. Kojic acid also prevents the undesirable melanosis (blackening) of agricultural products by inhibiting polyphenol oxidase.



Production of Kojic Acid

HIGH TEMPERATURE SUPERCONDUCTIVITY AND MAGNETIC THIN FILMS

Abdul Halim Shaari

Department of Physics

The Magnetic dopant such as Fe lowered the superconducting critical temperature (Tc) drastically as compared with non-magnetic dopant such Sn. YBCO doped with Sn is moisture-resistant than the pure YBCO. The effect of doping of various elements at the Ca and Cu sites in BSCCO system did not improve its Tc. Magnetic levitation force, due to Meissner effect, is studied as a function of dopant in both YBCO and BSCCO.

Levitation of a Magnet over a Superconductor

BioFil TECHNOLOGY FOR WASTE TREATMENT

Azni bin Idris

Department of Civil and Environmental Engineering

BioFil technology utilises the newly invented and innovative plastic media known as "Cosmo-ball", which provides the home for bacterial growth. The Cosmo-ball is a proprietary product, which is made of recycle plastic. BioFil system is useful for treatment of organic effluent such as palm oil mill effluent, paper waste, poultry processing and other strong organic wastes.

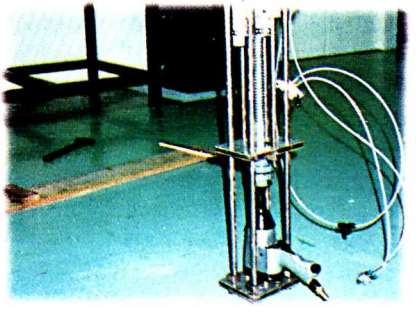
Proprietary "Cosmo-balls" Media for Biofil System

AN OIL PALM FRESH FRUIT BUNCH CUTTING DEVICE

Desa Ahmad

Department of Power and Machinery Engineering

A prototype oil palm bunch-cutting device that utilises an impact cutting action was designed and developed. The basic principle of the design was to transform the high torque rotational motion of the impact wrench to a vertical linear motion.



An Oil Palm Fresh Fruit Bunch Cutting Device

TELEPHONE-BASED SECURITY AND MONITORING SYSTEM

Md. Mahmud Hasan

Department of Computer and Communication System Engineering

A telephone line interface device has been developed. It is capable of auto dialling and/or responding on occurrences and can be accessed through a telephone line to get the current status of the occurrences. As an optional facility, a central control station can continuously (24 hours) monitor and report the distributed devices (critical time, vacation and/or home alone mode).

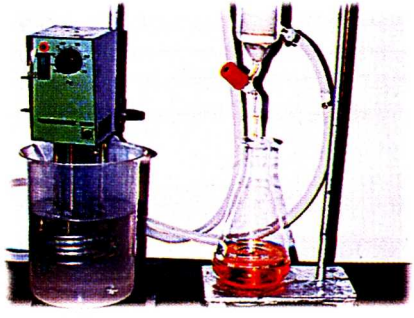
Security and Monitoring Systems

PRODUCTION OF NATURAL CAROTENE FROM CRUDE PALM OIL

Badlishah Sham Baharin

Department of Biotechnology

A physical process has been developed for the recovery of carotenoid without damaging the edible triglycerides of oil palm. The basic component is the adsorption column, which is packed with a synthetic porous polymer adsorbent specific for carotene. As the crude palm oil passes through the column, carotene is adsorbed on to the column, allowing the oil to flow through. Using a specific adsorbent for carotene, the process concentrates carotene in crude palm oil by 160 times. The eluting solvents are food grade and non-toxic.



Carotene from Crude Oil Palm

BREADED FRESHWATER FISH FILLETS

Jamilah Bakar, Siti Aini Hamzah and Wong Nga Shee

Department of Food Technology

Breaded freshwater fish fillet is a new, value-added product and can be classified as a convenience food. The product is first prepared as a fillet, then it will undergo basic pre-processing procedures, battering and breading. The product is then prepared for a quick frying procedure to stabilise the product prior to frozen storage. It can maintain a good acceptability or marketability for at least 6 months under normal frozen storage practices.

Fried & Cut-up Samples

FOOD FLAVOURINGS

Jinap Selamat, Jamilah Bakar, Nazamid Saari, Amin Ismail, Junainah Abdul Hamid and Nanirusla Adura Ishak

Departments of Food Science, Food Technology and Biotechnology

Hydrolysates produced from aquatic resources (such as from under-utilised species or by-products of the fish industry) impart a special unique flavour to products like soup mixes, porridge or snack foods. Due to its good quality protein and quantity they can also be used as a food supplement in formulations for the invalids, people who have undergone serious surgical operations and infant formulas. Formulations can also developed for patients with special dietary requirements.

Food Flavouring

CENTRE FOR NATURAL PRODUCTS RESEARCH AND SERVICES, (CENPROS)

Nordin Hj. Lajis

Department of Chemistry

The research projects currently in progress are: Arbutin production from a new plant source (Nordin Hj. Lajis); *Morinda elliptica* a potential source for anti-cancer agent (Norhadiani Ismail and Nordin Hj. Lajis); tissue culture of medicinal plants (Marziah Mahmood); a new potential anti-cancer agent from *Glycosmis calcicola* (Rutaceae) (Mawardi Rahmani); testing and assay services at UPM (Manaf Ali); functional properties of food components (Suhaila Mohamed), and Butulinic acid production from a new local plant source (Manaf Ali and Faujan Hj. Ahmad).

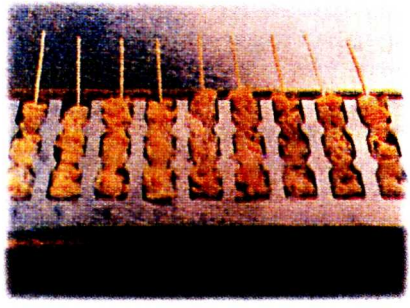
Potential Anti-cancer Properties

THE SATAY MOULD

Russly Abdul Rahman and Chong Sue Kheng

Department of Food Technology

The satay mould has particular application in satay production and provides a 'skewer-less' technique to hold meat fragments together. The skewer is inserted into the meat only as a carrier for manipulation. Skewering satay needs no longer be a constraint.



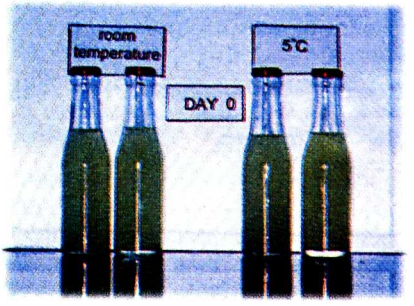
Satay Mould

NEW TECHNIQUE IN PRESERVING SUGARCANE JUICE

Salmah Yusof, Hasanah Mohd Ghazali, Russly Abdul Rahman and Dzulkifly Mat Hashim

Faculty of Food Science and Biotechnology

A physical process has been developed to preserve the colour of sugarcane juice as well as prevent microbial spoilage. Using this new technique, storage was enhanced from four to twelve days at 5°C.



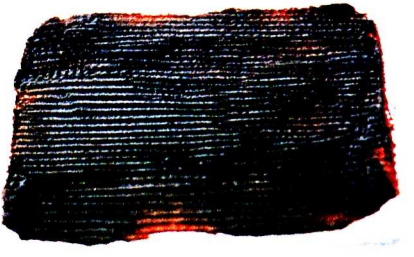
Bottled Sugarcane Juice

NEW TITBIT FROM ROSELLE *(HIBISCUS SABDARIFFA L.)*

Salmah Yusof, Hasanah Mohd Ghazali, Russly Abdul Rahman, Dzulkifly Mat Hashim and Azizah Osman

Faculty of Food Science and Biotechnology

A new product known as "roselle leather" has been developed from roselle *(Hibiscus sabdariffa L.)*. The ingredients are roselle puree, corn flour, sucrose, maltodextrin and sodium carboxymethylcellulose. Results of a taste panel evaluation showed that the product obtained was acceptable, equal to those of similar imported products.



Roselle Leather

ANTIBIOTIC-FREE CHICKEN

Ho Yin Wan, Norhani Abdullah and Jin Lizhi

Institute of Bioscience

Probiotics (direct-fed microbials) have been shown to increase the natural defence mechanism of chicken. A probiotic-fed chicken grows more rapidly, consumes less feed, has lower mortality rate, less pathogenic bacteria such as *Salmonella* and *E. coli* in its gastrointestinal tract, deposits less body fat, and has lower cholesterol level than chicken fed with no probiotics.

Probiotic Fed Chickens

TISSUE-CULTURE FOWL POX VACCINE

Aini Bt. Ideris

Department of Veterinary Clinical Studies

A fowl pox virus has been successfully cloned that can be adapted to chick-embryo fibroblast tissue culture. This technology of fowl pox vaccine production in tissue culture is the first to be developed in Malaysia. It is now produced commercially by Malaysian Vaccines and Pharmaceuticals Sdn. Bhd. and the product was launched in 1995.

Fowl Pox Vaccine

INTRANASAL PASTEURELLA SPRAY VACCINE

Mohd Zamri Saad, Mohd Effendy Abdul Wahid and Sheikh Omar Abdul Rahman

Department of Pathology and Microbiology

A vaccine has been developed to control pneumonic pasteurellosis caused by *Pasteurella haemolytica* infections in the lungs of goats and sheep. The vaccine used a locally-isolated *Pasteurella haemolytica* A2. It is prepared as a killed broth vaccine and administered by intranasal sprays.

Pasteurella Spray Vaccine

INFECTIOUS BURSAL DISEASE VACCINE *(UPM 93273)*

Mohd Hair Bejo, Hafiza Hashim and Aini Ideris

Departments of Veterinary Pathology and Microbiology, and Veterinary Clinical Studies

A live attenuated IBD vaccine was successfully prepared in embryonated chicken eggs from one isolate (UPM 93273). This new IBD is the first to be developed in Malaysia. The vaccine is highly immunogenic and it causes only mild lesions in the bursa of Fabricius and does not show any immunosuppressive effect. The product is being mass produced for field trials.

Infectious Bursal Disease Vaccine

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INVENTIONS,

INNOVATIVE

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AND PRODUCTS

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